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ROMAN SAMIAN WARE.

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(*With a Coloured Plate.*)

WHEREVER we dig upon Roman sites, whether in Britain, in Gaul, or in Germany, and especially on the sites of towns or large villas, we continually find specimens of a red ware, covered with a glaze which gives it the outward appearance of fine red sealing-wax, or of coral. Internally it is of a lighter red than the exterior glaze; and it is slightly porous, and sonorous when struck. It consists chiefly of bowls, cups, and pateræ or dishes, presenting a great diversity of form and design, but always elegant. It is sometimes quite plain, but more usually covered with ornament in relief, and often with figures of men and animals. Four examples of this pottery are given in our plate, and will furnish a sufficiently exact notion of its colour and other peculiarities. These peculiarities have given rise to two rather important questions, relating to its name and to the locality in which it was made, which have been the subject of some dispute among antiquaries.

It has generally, by a sort of involuntary consent, been termed Samian ware, though some have doubted the correctness of this name as applied to this pottery. Perhaps, however, the evidence in favour of this name, which is often mentioned by the classical writers, is greater than that against it. Pliny (*Nat. Hist.*, lib. xxxv. c. 46) informs us that the Samian ware was the favourite pottery for the service of the table among the Romans, which quite agrees with the forms of the red ware of which I am speaking. The Samian pottery of the Romans was, like it, red. The Samian ware was well known in Rome at so early a period, that Plautus uses the word as a symbol for brittleness, and we learn from Pliny that it was more highly valued than most other sorts of pottery. Plautus, in his comedy of the *Bacchides* (actus ii. sc. 2),

introduces Chrysalus, the servant, asking Pistoclarus if he has found Bacchis. "Her of Samos I have found," replies Pistoclarus. "Then," rejoins the other, "see, I pray, that no one handle her carelessly; a Samian vessel, you know, is used to be easily broken."

Ch. Eho, an invenisti Bacchidem?
Pis. Samiam quidem
Ch. Vide quæso, ne quis tractet illam indiligens.
Scis tu, ut confringi vas cito Samium solet.

And in the *Menæchmi* (actus i. sc. 2), when Peniculus, the parasite, strikes the door too hard, Menæchmus begs him to "knock gently," to which he replies, "I believe you are afraid that the door is Samian ware."

Me. Placide pulta.
Pen. Metuis credo ne fores Samiæ sient.

Every antiquary knows the brittleness of the red ware to which we have given the name of Samian, and how seldom it is found unbroken, except in sepulchral deposits; and we may conclude that it was highly valued, from the circumstance that we often find vessels of this ware which, in Roman times, have been broken and skilfully and carefully mended by means of rivets of lead or bronze.

Pliny adds to what he says of the estimation in which Samian pottery was held, that the pottery made at Arretium in Italy was still held in great esteem; and that the potteries of Surrentum, Asta, Pollentia, Saguntum in Spain, and Pergamus in Asia Minor, were esteemed for their cups only. The brevity of Pliny's language, perhaps, leaves it doubtful whether he did not mean that the ware made at these places belong all to the class which was called in general Samian, and a remarkable discovery of Roman potteries, and of specimens of the ware made in them, at the first of these localities, Arretium, now Arezzo in Tuscany, seems to throw light on the question. An account of these discoveries, with valuable plates, was published by Dr. A. Fabroni, director of the Museum of Arezzo, in 1841,* and a comparison of the examples given in this book with the red ware found in Britain and Gaul, will show that they are nearly identical in all their essential peculiarities. The red glaze of the Arretine ware differs only in its rather darker shade; the workmanship is somewhat superior, and the figures which ornament it are more artistically executed. But the character of the ornaments, and the general selection of subjects, are the same, and they are similarly executed in relief. In both the pottery is stamped with the names of the potters, but with this rather singular difference, that, while in the

* *Storia degli antichi vasi fittili Aretini.* 8vo.

Samian ware of Gaul and Britain the potter's stamp is almost invariably placed in the centre of the vessel inside, in the Arretine pottery it is always impressed on the exterior side.

Another circumstance has come under my observation, which tends to show that this description of pottery was made in various places throughout the empire, and that we are probably justified in giving the name of Samian to the red ware which forms the subject of the present article, and which therefore, I shall retain. A few years ago I received from the late Mr. Burckhardt Barker three pieces of pottery obtained from excavations made at Tarsus in Cillicia, which I subsequently presented to Mr. Mayer, of Liverpool, and they are now preserved in his valuable museum in that town. Two of them are represented in the accompanying cut, Fig. 1. To

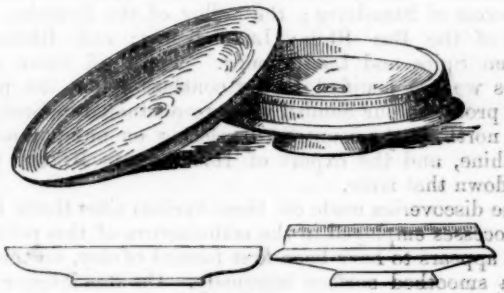


Fig. 1. Red Ware from Tarsus.

my surprise when I first saw them, these present all the peculiarities of our red ware, from which they differ very slightly in the shade of red presented by the glaze. They offer, also, forms exactly similar; but, as they are all three plain examples, we can form no opinion of the character of the ornament. The potters' names which appear on two of them, are impressed exactly in the same form as on our red ware, and, contrary to those of the Arretine ware, in the same place, as may be seen in one of the examples given in our cut. The names are Greek, and in Greek letters, which implies that they must have been made in the East; and they may possibly come from the very potteries of which Pliny speaks as existing at Pergamus.

The other question, that of the locality in which our Roman Samian ware was made, seems to admit of a more decisive solution. The general character of identity which marks the Samian ware found in Britain, Gaul, and Germany, would lead us naturally to suppose that it all came from one source, and

from one school of potters, and we should hardly look for these in our island. This identity is manifested not only in the general character of the pottery, and in its ornaments and designs, but in the names of the potters. From whatever country this numerous class of pottery came, the manufactories must have been very extensive, and we could hardly fail to find some traces of them. Now, among the rather numerous remains of potteries of the Roman period found in Britain, no trace of the manufacture of Samian ware has ever yet been met with. On the other hand, potteries of the Roman Samian ware have been found in various localities in Gaul, with the moulds in which the embossed ornamentation was cast, and the stamps with which it was impressed. Among the places at which these potteries have been met with, I may mention Lezoux, near Thiers, in Auvergne; Saverne, a few miles to the north-west of Strasburg; the valley of the Brusche, department of the Bas Rhin; Luxembourg; and Rheinzabern, between Spire and Lauterbourg. From all these circumstances we are justified in the conclusion that the potteries which produced our Samian ware were situated in Gaul, chiefly in the north, in the countries bordering on or approaching to the Rhine, and the export of this ware to Britain perhaps came down that river.

The discoveries made on these various sites throw light on the processes employed in the manufacture of this pottery. A mould appears to have been first formed of clay, on the wheel, with a smoothed surface internally. On this interior surface the ornaments and figures were stamped. The clay of which the vessel was to be made, was pressed into the mould, after which it appears to have been placed on the wheel, and the

Fig. 2. Potters' Marks.

internal surface of the vessel formed and smoothed. The potter's name was then stamped in the centre, across the bottom, and the whole was glazed and placed in the kilns. I saw, some years ago, in the cabinet of the late Comte de Portalès, in Paris, one of these moulds, found, if I remember right, at Luxembourg, in which this process was fully exemplified.

The potter's name was placed in a small rectangular label, as in the two examples to the right in our cut, Fig 2. The name was most commonly put in the genitive case, combined with O or OF, abbreviations of the word *officina*, as in the example given in our cut, where OF MODESTI stands for *officina Modesti*, *i.e.*, from the workshop of Modestus; or with M for *manu*, as COBNERTI M, for *Cobnerti manu*, by or from the hand of Cobnertus, Sometimes the name is given in the nominative case, followed by F or FE, for *fecit*, as COCVRO F, for *Cocuro fecit*, Cocuro made it. Doubled or ligulated letters are frequently introduced in these inscriptions, an example of which is given in the lower figure to the right, where the first letter is the ligulated T and E, and the name is TETTVR. Sometimes we meet with an error in the spelling of the word; and in one or two instances the person who made the stamp inscribed the name carelessly, so that it read direct on the stamp, and consequently it is reversed in the impression on the pottery. An example is given in the cut, where the inscription reversed reads PRASSO·O. The name is not always placed in a square label, though examples to the contrary are rare. In a few instances it has been found inscribed round a small circle. It is a peculiarity of the Arretine ware, described by Fabroni, that the label not

Fig. 3. A Potter's Stamp.

unfrequently assumes the form of the sole of a man's foot. The stamp of this form given in our cut occurs on a piece of the red Samian ware found at Lillebonne, in Normandy. The inscription appears to be HIL·O·L·TITI, which may perhaps stand for *Hilarii officina liberti Titi*, from the workshop of Hilarius, the freedman of Titus. As this combination of

names occurs also on some fragments of the Arretine ware, and the Lillebonne fragment is, like other examples found in England and France, of peculiarly fine workmanship, Mr. Roach Smith very reasonably concludes that the pottery of Arretium was brought into these western provinces. The cut annexed, Fig. 3, represents one of the stamps used for impressing the label with the potter's name. It was found at Lezoux, in Auvergne, and presents the name AVSTRI·OF, from the workshop of Auster. A similar die of a potter named Cobnertus is preserved in the museum at Sevres. Both these names are found on specimens of Samian ware found in England.

Similar dies for stamping the ornaments and figures have also been found in France. In the latter each die contained a single figure, or, at all events, a single group, and this explains why the same figures are so frequently found on the pottery in different combinations. One of these dies contains a single festoon and tassel of the well-known festoon ornament, so common on this pottery.

In London, and in some other localities in England and France, examples of this red Samian pottery have been found which differ in some essential particulars from that just described. The ware itself is of a finer texture, and the figures display a superior style of art, and are formed in higher and bolder relief. But its distinguishing peculiarity is the fact that the figures which ornament it were not stamped on a mould, as was the case with the red ware known to have been made in

Fig. 4. Samian Ware from London.

Gaul, but they were moulded separately, and attached to the vessel after it had been turned on the lathe. In the fracture of these vessels, the manner in which the figures were attached to the vessel becomes very apparent; and in some cases, the figure itself remains entire, while the side of the vessel is

broken from it. An example of this is given in our cut, Fig. 4, representing a fragment found in London, and preserved in the collection of Mr. Roach Smith, which (now transferred to the British Museum) contains several fine fragments of this peculiar variety of the Samian ware. It will be seen that here the head above and one leg below, have become detached from the pottery when it broke, the former remaining without any fracture. Examples of this pottery are very rare, both in France and England, from which circumstance Mr. Roach Smith thinks that it was not made in these provinces, but that it was imported from Italy, perhaps from Arretium.

The forms of the vessels of Samian ware, and of the ornaments lavished upon them, are so numerous and varied, that it would be impossible to give anything like a particular description of them without a great number of plates. Our plate presents four examples, all vessels found in London, and preserved in Mr. Roach Smith's museum. They will be sufficient to give a general notion of the character of the Samian ware. The ornamental borders which are most commonly met with are the elegant festoon and tassel borders, which appear in Figs. 1 and 4 of the plate, and the egg and tongue. Wavy lines, and lines of circles, are also common.

Fig. 5. Scrolls from Samian Ware.

We frequently meet with scroll-work of very elegant design, and commonly formed of leaves, flowers, and fruit. Two examples, selected from a numerous variety, are given in our cut, Fig. 5, both from Samian ware found in London. These scrolls are generally used to form a border round the upper part of the bowl. The foliage most in favour for these scrolls

was that of the vine and the ivy, and also that of the strawberry; the former of which especially shows that this pottery was, as Pliny says of the Samian ware, intended especially for the service of the table. The ivy-leaf, indeed, is almost the only ornament of the plainer description of this red ware. Sometimes the leaves of the vine are gracefully intermingled with the clusters of the fruit, and with little birds, which are preying upon the latter, as in the fragment represented in our cut, Fig. 6.

Fig. 6. Ornament of Vine-leaves and Grapes.

Animals of all kinds are found in abundance among the ornaments of our Samian ware. Among these the boar was a great favourite. The cup, Fig. 1 of our plate, is divided into compartments, in which figure alternately two boars, and a man confronting them with a spear. In a similar compartment under arches, in Fig. 2 of our plate, we have two heads of lions above, and, below, a rabbit and a dog. The bowl, Fig. 3, on the same plate, is ornamented with fishes, separated by squares filled with a singular ornament, which is, perhaps, intended to represent water. Sometimes the whole outside of a bowl is covered with birds, beasts, and fishes, mixed together in the utmost confusion.

The subjects in which figures are introduced present still greater variety, and it need hardly be added that they are much more interesting. Subjects from the classical mythology are very common, and among the figures of the deities we recognize some, such as the Venus de Medici, which were copied from well-known models of art. Combats of pygmies and cranes appear as favourite subjects, as in the paintings, etc., in Pompeii. Sacrifices and religious ceremonies are not uncommon; and especially bacchanalian processions, and

dances of bacchantes and satyrs, another proof that this ware was used for the festive board. The spirited manner in which these subjects are often treated, may be illustrated by the fragment copied in our cut, Fig. 7, which is part of a bacchanalian scene, in which Silenus figures among satyrs and fauns. A faun is drinking from a horn supplied from a wine skin which he holds in his left hand, while Silenus attempts to snatch it from his hands. Genii, one of whom appears with wings on another fragment of the same vessel, appear to be directing or

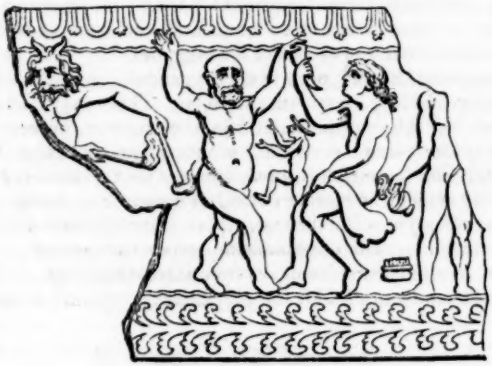


Fig. 7. A Bacchanalian Group.

presiding over the scene. Among other very favourite subjects are hunting scenes, gladiatorial combats, and the sports of the amphitheatre. Others represent sacrifices and religious offerings. Musicians performing on various instruments are also common; and domestic scenes are depicted in great variety. Many of these are of a character not to be described, but sufficiently characteristic of the degraded state of morality under the Roman empire. The bowl, in the fourth figure on our plate, is ornamented with a series of figures, which appear to have no connection with one another. In the middle is a Bacchanal with his thirsus; to the right of him, a figure playing on the double pipe; on both sides a group of bears; and to the extreme right a charioteer, followed by a bear "rampant."

The convivial purposes to which much of this Samian ware was intended to administer, is further illustrated by inscriptions on some examples found in France, especially at Boulogne. These, which are given in the first volume of Mr. Roach Smith's valuable *Collectanea Antiqua*, are, on one, AVE, *i.e.*,

hail! on another, VIVAS, may you live! on a third, BIBE, drink; and on a fourth, IMPLE, fill! I believe an example has been found in England with an inscription, urging the person who used it to drink heartily; but such inscriptions are rare.

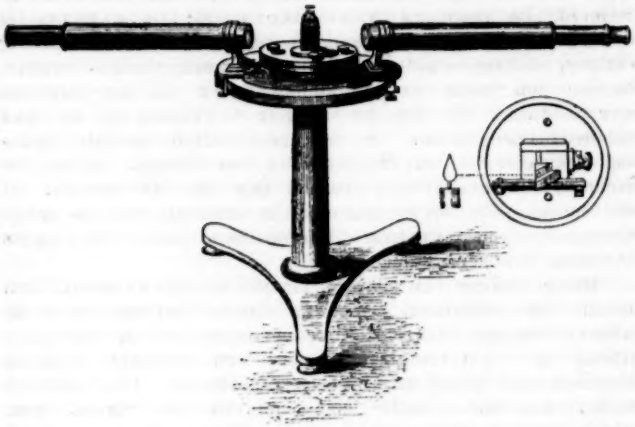
The great quantity of this Samian ware which is found on Roman sites, admits of easy explanation, from the circumstance that it was held in great favour, and that the manufactories on the Continent continued to work with activity in producing it during the whole Roman period. The number of names of potters, collected from fragments found in England alone, amounts to more than two thousand, and we must suppose them to have been spread over a long period. Yet it is somewhat singular that we perceived no gradual change in the style of art they display, or in the subjects. This may, perhaps, be explained by the supposition that the potters preserved traditionally the same series of subjects, and perhaps the very dies which had stamped them, during two or three centuries; and that, even at the latest period, a figure, or a group, bearing the marked style of the age, was only introduced for some special cause. This explanation seems to receive a rather singular confirmation from a very interesting vase of Samian ware in the museum of Mr. Roach Smith, of which he has given

Fig. 8. Victory Crowning a Warrior.

an engraving in the second volume of the *Collectanea Antiqua*, p. 13. It was found in a Roman villa at Hartlip, in Kent, and bears distinctly the evidence of being a work of very late date. It has the potter's mark, SABINI·M, in late-formed characters, without a label, stamped on the exterior side, in the manner of the Arretine ware, and not across the bottom inside. The mythological figures on this vase, such as Leda and the swan, and Diana returning from the chase, and carry-

ing her bow in one hand and a hare in the other, are evidently from old dies belonging to an earlier period; but in the middle is a group of figures, copied in our cut, No. 8, representing Victory, holding a palm branch, and crowning with a wreath a warrior who wears the paludamentum, or military garment, over a tunic. He appears to have a helmet on his head adorned with a plume. In fact, the costume and the Byzantine character of art displayed in the design, cannot be referred to a period more remote than the fifth century. It will be seen, by a single glance at the original, that this group belongs to a period entirely different from that of the figures by which it is surrounded.

Before leaving the subject, it will be well to remark that, besides the continental red ware above described under the name of Samian, examples have been found of an attempt to imitate it. This imitation pottery was probably made in England, and is not found in any abundance. It is lighter in colour, and has a duller glaze than the true Samian ware, which, however, it resembles in its forms. It is generally plain, but Mr. Roach Smith has given, in his *Collectanea*, engravings of two very curious attempts to imitate the embossed ornaments of the Samian ware. One of these (*Collectan.* vol. i. p. 159), found at Castor, in Northamptonshire, by Mr. Artis, was a piece of a bowl, the design upon which was evidently copied, but very unsuccessfully, from a Samian ware model. The other (*Collectan.* vol. iv. p. 63) was found at Oundle, in Northamptonshire. Mr. Smith describes it as made of a light red clay, glazed within and without with a thin reddish-brown and somewhat lustrous glaze. In substance it is not so compact and hard as the Samian ware; but the figures are equally well executed with the best of the usual Samian ware designs. The mark of the potter's name, stamped on the external side, is OF·LIBERTI.



SPECTROSCOPE APPARATUS.

In our first volume, p. 362, we published a paper on "Spectrum Analysis," in which the elementary principles of the process were explained; and in vol. iii. p. 338, will be found a very important article by Mr. William Huggins on "Spectrum Analysis applied to the Stars." In this paper, Mr. Huggins details many interesting results, arrived at through his own admirable investigations, and he prefaces this part of the subject by a very lucid explanation of spectroscope philosophy. Diagrams are also given of the spectra of several of the most important metallic and other substances, and of those afforded by α Orionis, Sirius, and Aldebaran. Since this account was written, Mr. Huggins has continued his researches with a perseverance and skill that have placed him in the first rank of observers, and enabled him to throw light upon questions of the highest interest in astronomy and physics. We hope very shortly to lay before our readers a full account of these investigations; and, in the meanwhile, proceed to offer some remarks which may assist those who desire to enter upon spectroscopic inquiries, or to understand what other investigators have done.

We recommend those to whom the question is still new, to consult the two articles to which we have referred, as they will thus obtain the information necessary for the commencement of the study. We shall in this place merely remind them that a solar spectrum, or prismatic image of the sun, consists of a ray of sunlight opened like a fan, and spread out so as to

exhibit exquisite gradations of colour, from red at one end to violet at the other. If we attempt to form a spectrum by allowing a broad mass of light to fall upon a prism, we shall only partially succeed. We shall indeed see rainbow colours, but they will be overlapped and confused. If, however, we permit the light to reach the prism through a narrow slit, and exclude extraneous rays, the confusion will be avoided, and a neat, well-defined ribbon of parti-coloured light will be obtained, in which, at certain intervals, dark lines will be observed. These lines, which would appear to a casual observer as insignificant as so many threads of a cobweb, are the hieroglyphic letters which the spectroscopist has to decipher, in accordance with the principles explained in the articles to which we have already made reference. To Sir J. Herschel belongs the credit of first pointing out that as the spectra of incandescent volatilized substances differed from each other, they might be made use of for purposes of analysis. There are only two modes in which such spectra can differ from each other, or from the solar spectrum which may be taken as a standard. Either they will afford bright lines in the place of dark lines, or dark lines in place of light ones. We have used the term *lines*, but when the breadth is considerable, *spaces* or *bands* is a better appellation.

When a glass prism acts upon a ray of light so as to give a spectrum, two distinct actions take place. First, the light ray is *refracted*, or bent out of its course; secondly, it is opened or spread out like a fan. This last action is called *dispersion*, and, like refraction, its amount varies with the substance employed in the formation of the prism.

For the detection of the metals and many other substances, a very minute examination of the spectrum is seldom required, as the spaces or bands by which their presence is indicated are conspicuously shewn by any instrument that will display the chief lines of the solar spectrum. There are, however, many thousand finer lines that can be discerned if a sufficiently powerful and delicate apparatus is employed, and many lines that appear single under ordinary circumstances are found to be multiple when examined with superior means.

The size and character of the spectroscope should be regulated by the work required of it. A very small one, that can be carried in the waistcoat-pocket, will serve to indicate the presence of the most characteristic substances, or to show to the traveller whether the atmosphere—as is often the case of an afternoon and in thunder-storm weather—developes any lines of moderate magnitude that are not regularly seen. A small spectroscope however labours under two obvious limitations: Its prism cannot usefully receive much light; opening

the slit too wide introduces confusion, as just explained, and its length must be proportioned to the size of prism, and consequently be restricted when a little one is employed. Then the telescopes attached to a small spectroscope are of small aperture and short focal length, with the consequent disadvantage of losing light, and being deficient in *separating* power. So important is the size and focal length of the telescope, that an apparatus of four prisms and three-feet telescopes exhibits more lines than one of nine prisms furnished with two-feet telescopes. The focal length of the collimating telescope determines the apparent size of the slit. If it is short, and the curves of its glass considerable, the slit looks wider, and all the lines are spread. This action when noticed by Mr. Browning, induced him to recommend and apply telescopes of much greater focal length than had hitherto been used in spectroscope apparatus. The first requisites for a better examination of spectra will then consist in a larger prism, with telescopes of larger aperture and greater focal length. They collect more light, and are better able to separate closely adjacent lines. The larger apparatus, if equally good in its corrections and adjustment, will show the colours brighter, the lines sharper and much more numerous, and will separate or "resolve" more of the compound lines. It will also give an intelligible spectrum, with a quantity of light that a smaller instrument could not work with.

For the traveller and casual observer the small pocket form answers well. The chemist and physicist requires, for many purposes, more light, a wider dispersion, and a greater resolving or separating power. For ordinary laboratory use, none of these properties are needed in excess; and a single fine prism, with two large telescopes, as in the apparatus of Mr. Browning, shown in the annexed cut, is amply sufficient. With this instrument the entire spectrum can be displayed at once with a magnification of 30 or 40, and a lower positive eye-piece, conveniently furnished with cross wires, enables all the principal lines in the darker part of the spectrum, as well as in the more luminous, to be seen distinctly, and their position noted down. This spectroscope, with one prism of 60°, and telescopes of an inch and a quarter clear aperture, and about 18 inches focal length, is vastly better than those which Mr. Browning made at an earlier period on Mr. Crookes' pattern, with two prisms, and telescopes of smaller size.

We may take this new instrument as the best in quality and form that has been produced to meet ordinary requirements; and, for common purposes, a more elaborate and complicated apparatus is not necessary, and, indeed, would not always be advantageous. The eye soon gets accustomed to the appearances

of different spectra, and a momentary glance would suffice to show whether sodium, potassium, lithium, silver, etc., were absent or present. But it is necessary that the exact position of the lines or bands should be ascertained, and that means should be provided by which exact diagrams may be made. Hitherto only superior instruments, beyond the reach of ordinary students, have been furnished with these desiderata; but Mr. Browning has now supplied them, in the instrument figured, in a convenient form, and at a very low price. One of the telescopes in the instrument we are describing moves over a graduated arc, read off to one minute by a vernier. Any line taken as a starting-point is brought into the centre of the field, so that it forms a perpendicular, cutting through the centre of the cross wires with which one eye-piece is furnished. The telescope is then clamped and the vernier read. Other lines are taken in succession, and their exact angular distance ascertained. When only moderate accuracy is needed in a diagram, a piece of paper can be ruled to a scale, and the lines laid down accordingly. Great nicety is not, however, to be obtained in this way; and Mr. Beckley, of the Kew Observatory, suggested the plan of a "spectrograph," which Mr. Browning has carried out with his accustomed skill.

This instrument is composed of a cylinder capable of being rotated, and fixed at any point. It carries a graduated scale exactly corresponding with the scale of the spectroscope, so that when the cross wires of the latter instrument intersect a line, which when read off on the vernier stands at, say 10°, the cylinder can be adjusted so that a delicate metal ruler indicates the exact spot on which a line should be drawn on a slip of paper which the cylinder carries. If the next line to be mapped down is 5° distant from the first, the cylinder is moved accordingly, the ruler is again in its exact place, and the second line is drawn as correctly as the first. This instrument thus enables diagrams to be made with precision, and a hundred observers in different parts of the world, furnished with spectroscopes and spectrographs, properly graduated, would be certain of producing diagrams capable of the exact comparison that science needs. The spectroscopes that can measure fractions of a minute can be furnished with spectrographs of proportionate delicacy.

It is often advisable to have two spectra in the field at once in order that their discrepancy or conformity may be ascertained by mere inspection. This was accomplished first, we believe, by Frauenhofer. In Mr. Browning's instrument it is effected in a very simple way. Half the slit of the spectroscope is permitted to receive light from a source directly in front of it. The other half of the slit is covered by a small right-angled

prism which prevents direct light getting in, but reflects rays that reach it at right angles to the axis of the instrument. The diagram showing the spectroscope will explain this. The part of the slit not covered by the little prism is supposed to receive light from a source opposite to it, while the light of the candle (shown in the figure) instead of passing straight through the prism, and continuing its course without entering the slit, is reflected from the inner surface of the prism, and thrown through the slit exactly in the right place. Mr. Browning has done wisely in adding this apparatus to his economical spectroscope, and also in providing a convenient holder for a test tube to contain liquids that exhibit Professor Stokes' absorption bands, of which we may say more another time.

For special purposes it is necessary to view and measure the position of the more delicate lines which the spectrum contains, and to separate some which look single with ordinary means. It would at first seem that the way to do this would be to employ more magnification—to treat, in fact, the close lines as we do those on diatoms, and separate them by magnifying power. Practically this plan only admits of very restricted application; and in the splendid Gassiot spectroscope, made by Mr. Browning, no deep eye-pieces are employed. Two plans are adopted to get over the difficulty—the spectrum is made wider by greater *dispersion*—our fan of light is spread out more; and telescopes of large aperture and greater focal length furnish the spectroscopist with a greater resolving or separating power, the increase of magnification being produced by the object glasses instead of the eye-pieces.

The reader will appreciate the difference between magnifying a spectrum of given dispersion and viewing a spectrum of greater dispersion, by remembering our illustration of the *fan*. Let a fan be opened, so that a portion of the pattern painted on its spokes is concealed by overlapping. It is obvious that magnifying the fan in this state can give us no information concerning the part which is covered up. If we open the fan still more, the concealed parts will come into view. This corresponds with the additional dispersion that we must give to a spectrum that has been imperfectly spread out, in order to see the entire pattern it can show.

To spread the light out wider, a multiplicity of prisms may be employed. The Gassiot spectroscope—the finest instrument yet finished of its kind—has nine prisms, about two and a half inches long, and two high, and was originally supplied with telescopes of two inches aperture, and two feet focal length. Two fresh telescopes have recently been made for this instru-

ment, of two and a half inches aperture, and three feet focal length. These show many additional lines. With this instrument a very careful survey and mapping of the spectrum is being carried on, and the results will, no doubt, be the most precise and complete information concerning the number and position of the dark lines that has yet been obtained. The size of the Gassiot spectroscope enables it to give a bright image with a small allowance of light; but certain inquiries in which Mr. Huggins is engaged need a further extension of power in this direction, and Mr. Browning is constructing for him a monster instrument, with about half the number of prisms on Mr. Gassiot's instrument; but these prisms fully double the size of Mr. Gassiot's, and furnished with telescopes of four feet focal length, and proportionably large aperture. With this splendid and costly apparatus—which has quite novel and special means for increasing the dispersion when deemed necessary—it will be possible to obtain great separation with a minimum loss of light, so that the spectra of very feebly luminous bodies may be made out.

In these two great spectroscopes the extra separation is produced by the multiplication of glass prisms, and when these are of fine quality and exquisitely wrought, the definition is the sharpest that can be obtained.

Different substances vary in their refractive and dispersive powers. Sir J. Herschel observes, "*in general*, high refractive is accompanied by high dispersive power; but exceptions are endless, especially among the precious stones, of which the diamond affords a striking instance."

If the two powers had always gone together, we could have had no achromatic lenses; but happily by selecting different kinds of glass, and setting them to opposite work, we can correct all (or nearly all) the error arising from dispersion, and only neutralize a portion of the refraction. When greater dispersive power is required in a prism than ordinary glass exerts, another kind of glass may be chosen, or recourse may be had to a liquid like bisulphide of carbon, which gives a very wide spectrum. A liquid has the disadvantage that it cannot be maintained in the prismatic form except by putting it in a vessel of the required shape. Hollow prisms are accordingly made of thin glass, and filled with the fluid required. Mr. Browning has made a spectroscope of this kind for Mr. Gassiot. It consists of eleven prisms, with telescopes two and a half inches aperture and three feet focal length, and it is able to separate the principal soda lines to the extent of 3′ 6″, the nine glass prisms only separating them 1′. The definition is excellent while the fluid is of uniform temperature and density; but becomes very bad as soon as the heat which accompanies

the light ray, or arises from any other source, has disturbed its homogeneous character. This instrument is described by Mr. Gassiot in *Proceedings of the Royal Society*, No. 63. The prisms are formed with a refracting angle of 50°, and consequently eight prisms, with the usual arrangement, would "cause a ray of light to travel more than a circle." In order to employ eleven, Mr. Browning, instead of making the outer sides of each hollow prism *flat*, formed them of crown glass prisms, having a refractive angle of 6°, the angles being arranged in the contrary direction to those of the fluid prisms. These sides take off very little of the dispersive power of the bisulphide, and enable eleven prisms to be employed.

The dispersive power of glass or any other substance depends upon the different refrangibility of the different rays that make up white light. A beam of white light contains an infinite number of rays of all hues, from red to violet (besides rays invisible to man). Each ray takes its own bend on passing through the prism, and is thus more or less separated from other rays that are bent in a different degree. When this dispersive process has completely separated any ray from its companions, passing it through another prism simply *refracts* it, without any action on its colour. But if a ray is imperfectly separated from adjacent rays in the scale, the further action of one or more prisms carries on the work of separation until it is complete. In a spectrum formed by slight dispersion the red, yellow, green, and blue are seen in bands that contrast strongly with each other. When the dispersion is more complete, the intermediate tints are innumerable, and one passes into the other by insensible gradations. The artistic effect of a slightly dispersed spectrum is a brilliant but violent contrast of dissimilar colours. That of the highly dispersed spectrum is a harmonious juxtaposition of all the colours in the scale.

As the human ear cannot hear all sounds, so the human eye cannot see all rays of light. There may be sounds too sharp—consisting of vibrations too rapid—for the ear to perceive them, and sunlight has rays which must undergo a change before our eyes can bring them to a focus. Glass absorbs many of these rays, which are highly refrangible. Quartz transmits them, and hence a prism of that substance adds them to the spectrum which it forms. If such a spectrum is received on a screen prepared with a substance called *æsculin*, obtained from the horse chesnut, or with an alcoholic solution of stramonium, they are sufficiently altered in refrangibility to become visible, and a beautiful blue addition to the violet end of the spectrum is seen. It is very difficult to find a large quartz crystal that can be cut into a good prism, but Mr. Gassiot obtained a splendid one from Japan, and Mr. Browning worked it into a prism of 60°, with 2¼-inch sides.

The different spectroscopes to which we have alluded are all constructed upon the principle of *indirect* vision. That is to say, the observer does not point the telescope straight at the light he wishes to see. It reaches him round the corner through the refraction of the prism. This plan is handy enough for fixed apparatus, but for rapid examination of the light that comes from different portions of the sky, or from radiating objects, a spectroscope of direct vision is preferable. Mr. Browning effects this by placing a dense flint glass prism of 60° between two prisms of light crown of 22°. Other opticians follow the same principle, with variations of detail. Such spectroscopes act clearly, but they lose much of the dispersive power of the chief prism. In Mr. Browning's pattern the loss is about one-third. Although employed by Secchi and other eminent observers, spectroscopes of this kind are by no means the best for astronomical research; though *amateurs* who merely desire to see the principal lines which bright celestial objects afford, will probably find them adapted to their purpose.

Although we must not now anticipate the paper on Mr. Huggins' recent discoveries, which we shall shortly publish, we may describe the arrangement with which he arrived at the wonderful fact that the spectra of certain nebulæ resemble those afforded by highly rarefied and intensely heated gases. The rays from the object-glass of his telescope are received by a cylindrical lens of half-inch focus, on emerging from which they enter the slit of the collimator. The spectroscope has two prisms, and is furnished with a micrometer screw. This apparatus was constructed by Mr. Browning.

One of the most interesting branches of spectroscope inquiry is the absorption of certain portions of the spectrum by solutions. The fluid can be put in a test tube; but for many of these experiments a *prismatic cell* is better. This consists of a rectangular glass cell, one side of which is composed of a prism. When the solution to be examined is put in the cell, it forms a fluid prism; and if the glass prism and the solution prism correspond pretty closely in refractive power, one undoes the refractive work of the other, and thus light is permitted to come straight through the combination to the slit of the collimator.

To view the spectra of gases, narrow tubes are employed, in which the gas, in a highly rarefied state, is rendered incandescent by the discharge of a Ruhmkorff's coil.

In all spectroscope experiments, the edges of the slit of the collimator should be kept very clean. Dirt particles, or rust, give rise to vexatious black lines traversing the spectrum from end to end. Mr. Browning informs us that they are best removed by the gentle action of a thin wedge cut out of hard slate pencil.

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

BY G. M. WHIPPLE.

1884.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2·30 P.M., and 5 P.M. respectively.		Rain—read at 9·30 A.M.
Day of Month.	Barometer, corrected to Temp. 32°	Temperature of Air.	Calculated.			Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	
			Dew Point.	Relative Humidity.	Tension of Vapour.						
	inches.	°	°		inch.	°	°	°			inches.
July 1	29·946	56·2	39·5	·56	·460	64·4	49·4	15·0	8, 8, 8	NW by W, SW, WNW.	0·000
„ 2	29·759	60·1	47·6	·65	·525	69·9	49·5	20·4	9, 4, 8	SW by S, SSW, S by W.	·000
„ 3	...	...	...	...	...	61·9	50·7	11·2	...	...	·120
„ 4	29·983	56·5	44·1	·65	·465	66·6	45·5	21·1	2, 9, 10	WSW, W by N, W.	·282
„ 5	30·010	60·7	39·9	·49	·535	70·0	46·2	23·8	1, 1, 3	WSW, NW by W, N by W.	·000
„ 6	30·138	57·7	43·0	·60	·484	66·2	46·2	20·0	6, 9, 10	N by E, N, WSW.	·000
„ 7	30·109	58·4	48·1	·70	·496	67·8	51·3	16·5	9, 8, 10	SW by S, NW by N, N.	·000
„ 8	30·143	53·5	45·0	·75	·420	60·0	44·8	15·2	8, 8, 10	NW, NE, NE.	·000
„ 9	30·072	52·5	45·3	·78	·406	61·8	47·5	14·3	8, 9, 10	NE by E, NE by N, ENE.	·000
„ 10	...	...	...	...	...	71·8	50·6	21·2	...	...	·003
„ 11	30·041	67·8	51·7	·58	·676	77·0	53·6	23·4	5, 4, 2	NNE, SE, E.	·000
„ 12	30·073	60·1	49·7	·70	·525	71·4	51·7	19·7	10, 3, 2	NE, NE by E, NE.	·000
„ 13	30·010	57·6	48·0	·72	·483	67·8	49·9	17·9	10, 6, 1	N by E, ENE, —.	·000
„ 14	30·074	62·8	45·8	·56	·574	75·4	47·9	27·5	10, 1, 0	NE, N, NNE.	·000
„ 15	30·078	65·4	46·7	·53	·625	75·3	45·6	29·7	10, 5, 8	NW by N, E by N, E by N.	·000
„ 16	30·113	61·4	51·1	·71	·548	71·8	52·2	19·6	10, 0, 0	NE by E, E, ENE.	·000
„ 17	...	...	...	...	...	75·7	49·3	26·4	...	...	·000
„ 18	30·071	64·5	53·3	·69	·607	73·3	53·1	20·2	10, 7, 9	S by W, N by W, NE.	·063
„ 19	30·068	72·1	53·8	·55	·778	80·7	57·8	22·9	7, 7, 5	NW by W, N by W, NW by N.	·000
„ 20	30·020	72·5	52·7	·52	·788	81·8	55·8	26·0	3, 2, 3	W, W by N, —.	·000
„ 21	29·871	65·7	51·2	·61	·631	76·4	54·2	22·2	4, 1, 7	W by N, WSW, SW.	·000
„ 22	29·871	61·7	52·4	·73	·553	70·9	52·8	18·1	5, 9, 10	W, SW, SW.	·085
„ 23	29·982	66·0	48·3	·55	·638	75·1	55·2	19·9	9, —, 0	W by S, W by N, WSW.	·000
„ 24	...	...	...	...	...	75·1	52·9	22·2	...	...	·000
„ 25	29·752	59·2	52·5	·80	·609	70·7	52·9	17·8	10, 8, 9	WSW, SW by S, SW.	·098
„ 26	29·847	63·0	46·4	·57	·578	71·6	55·9	15·7	7, 4, 4	WNW, W by N, N by E.	·020
„ 27	29·929	64·3	47·9	·58	·603	75·6	47·8	27·8	5, 4, 3	S, S, S by E.	·000
„ 28	29·822	66·1	52·7	·64	·640	73·3	55·3	18·0	5, 8, 7	SW by S, SW by S, SW by S.	·000
„ 29	30·057	66·5	46·6	·51	·648	77·1	52·7	24·4	4, 4, 3	WNW, WSW, W.	·000
„ 30	30·158	65·5	59·9	·83	·627	76·3	53·6	22·7	10, 9, 9	SW, SW, SW by S.	·000
„ 31	...	...	...	...	...	78·6	57·4	21·2	...	...	·000
Monthly Means.	30·000	62·2	48·6	·64	·570	...	...	20·7	...	...	0·671

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—June, 1864.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour.																																
12	6	3	10	9	8	5	1	0	5	13	12	9	14	11	0	11	3	1	2	5	5	6	5	4	5	12	1	8	7	4	7	6·2
A. M. 1	8	3	12	6	8	7	3	2	6	1	11	11	13	10	1	6	1	3	5	4	10	5	6	3	5	13	1	7	6	5	8	6·5
2	9	5	11	8	7	5	3	2	6	7	12	10	13	10	0	8	3	5	3	3	6	5	6	4	5	12	0	7	6	6	7	6·3
3	8	6	11	6	5	3	4	1	7	10	13	13	16	6	1	11	2	2	2	3	7	8	3	3	8	10	1	9	4	9	6	6·4
4	9	6	11	5	4	1	3	2	8	10	14	15	16	13	0	11	2	1	3	5	5	7	5	3	10	7	2	6	6	4	4	6·4
5	8	7	12	5	8	3	2	4	11	10	12	12	14	5	1	10	3	2	2	3	6	11	5	6	10	7	2	7	5	6	5	6·6
6	13	13	14	8	12	4	4	4	12	10	17	13	13	4	1	10	2	3	3	3	6	9	5	8	8	11	2	13	7	10	6	8·0
7	13	15	13	10	13	7	3	8	14	15	18	12	10	6	2	10	2	3	4	6	8	13	10	8	10	10	3	15	9	15	5	9·4
8	15	22	12	12	12	8	4	12	10	15	17	14	13	4	3	10	1	1	3	4	12	12	10	12	10	12	6	19	9	13	7	10·1
9	14	18	13	12	15	10	4	11	10	19	17	9	5	8	2	10	1	6	4	2	15	14	10	11	9	11	11	19	10	15	7	10·4
10	15	21	12	12	17	8	4	9	12	26	18	12	13	7	3	15	2	7	7	9	17	17	12	17	12	12	13	20	10	18	6	12·4
11	13	20	11	11	12	10	9	9	17	24	22	10	17	4	9	10	5	8	6	8	15	15	11	20	13	13	12	19	8	22	12	12·7
12	15	25	14	14	15	9	9	10	15	24	30	11	18	5	13	11	3	10	7	8	15	15	10	17	12	13	11	18	9	20	19	13·7
P. M. 1	12	27	15	13	14	10	6	8	15	22	28	14	20	6	12	11	1	12	9	8	20	11	10	19	20	11	11	19	10	20	18	14·0
2	12	19	19	15	16	9	8	7	13	23	27	15	22	5	15	13	1	10	4	9	20	10	11	21	19	10	14	17	10	19	25	14·1
3	11	30	12	15	17	7	7	9	15	24	28	14	22	6	15	12	4	9	6	5	19	19	12	21	20	6	14	15	8	18	27	14·4
4	12	21	14	14	16	9	12	10	11	24	25	17	23	7	18	15	4	11	3	8	19	18	13	22	20	8	17	16	11	18	24	14·8
5	9	24	15	14	13	5	10	9	13	26	20	14	18	5	15	11	3	10	6	7	17	15	14	20	20	4	11	16	6	17	21	13·2
6	6	21	11	12	15	5	10	6	11	18	17	15	14	6	14	10	12	10	4	10	11	11	9	20	17	5	11	13	8	15	20	11·8
7	5	24	13	10	8	10	11	5	11	17	13	13	7	3	10	9	7	5	3	10	14	11	10	16	16	3	10	14	6	15	21	10·7
8	5	19	9	7	12	8	8	5	14	15	8	13	3	7	8	7	2	0	5	9	8	12	6	13	15	1	8	10	5	10	20	8·8
9	6	15	10	8	5	5	5	5	15	14	14	21	5	5	9	9	8	1	5	6	8	9	7	7	18	3	8	11	5	5	19	8·8
10	4	12	11	7	7	2	8	6	13	19	15	18	5	4	9	8	2	1	5	9	7	9	7	9	16	3	6	9	4	5	18	8·3
11	5	15	7	8	5	3	5	3	12	16	10	13	8	1	10	1	2	1	2	6	6	10	5	5	10	3	9	6	3	8	20	7·0
12																																
Total Daily Movement.	233	391	292	241	264	153	143	147	276	412	418	321	322	148	171	239	76	122	103	150	276	272	202	293	308	200	184	313	172	297	332	10·0

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1864.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2.30 P.M., and 5 P.M., respectively.		
			Calculated.								
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9·30 A.M.
	inches.	°	°		inch.	°	°	°			inches.
Aug. 1	30·026	62·6	42·5	·51	·570	70·4	54·2	16·2	7, 4, 3	SSW, W by S, W.	0·000
„ 2	30·112	59·5	41·1	·53	·514	68·6	49·0	19·6	7, 7, 4	NW by N, NW, NW.	·000
„ 3	30·090	63·6	41·1	·47	·589	73·7	42·2	31·5	3, 1, 1	NE, N, —.	·000
„ 4	30·031	68·5	44·7	·45	·692	78·5	52·3	26·2	0, 3, 6	SW by W, WSW, W by S.	·000
„ 5	30·101	74·5	51·1	·46	·840	84·5	54·9	29·6	0, 2, 3	S by W, S, SW by S.	·000
„ 6	30·049	68·6	53·1	·60	·694	79·8	58·9	20·9	10, 4, 4	NW, S by E, WSW.	·000
„ 7	...	...	...	...	...	77·7	49·8	27·9	...	...	·000
„ 8	29·861	67·9	55·7	·67	·678	77·6	60·6	17·0	10, 5, 5	W, WSW, W by S.	·000
„ 9	29·809	56·5	57·4	1·00	·465	66·9	54·6	12·3	10, 10, 10	NNE, WSW, W.	·313
„ 10	30·068	56·7	38·7	·54	·468	64·4	47·2	17·2	5, 9, 7	W by S, WNW, NW.	·163
„ 11	30·314	57·5	37·0	·49	·481	66·6	45·8	20·8	7, 2, 1	N, NW by N, NE.	·000
„ 12	30·321	65·2	43·4	·48	·621	73·4	42·5	30·9	2, 7, 3	SW, —, SW by W.	·000
„ 13	30·327	67·6	49·6	·55	·672	76·4	45·5	30·9	7, 0, 2	—, E, E by N.	·000
„ 14	...	...	...	...	...	75·3	49·6	25·7	...	...	·000
„ 15	30·383	64·9	52·3	·65	·615	74·0	52·3	21·7	0, 0, 1	NE by N, NNE, N.	·000
„ 16	30·228	64·0	57·1	·80	·597	73·3	51·3	22·0	10, 7, 9	NE by N, N by W, S by W.	·000
„ 17	30·065	59·1	43·0	·58	·507	67·1	55·5	11·6	0, 6, 6	NE by E, NE, NE.	·000
„ 18	29·930	56·8	38·3	·54	·470	64·6	44·1	20·5	3, 7, 6	—, N, NE.	·000
„ 19	29·683	59·1	37·2	·47	·507	66·6	40·4	26·2	2, 7, 6	SE by E, E, ESE.	·000
„ 20	29·793	54·8	43·9	·69	·439	63·3	50·4	12·9	5, 9, 10	NE, NE, SSW.	·010
„ 21	...	...	...	...	...	65·4	43·2	22·2	...	...	·190
„ 22	29·919	53·9	43·9	·71	·426	62·5	42·7	19·8	7, 10, 10	NE, E, E by N.	·213
„ 23	29·730	48·4	43·1	·83	·353	55·7	47·9	7·8	10, 10, —	NNE, NE by N, N by E.	·296
„ 24	30·060	53·8	35·8	·54	·425	60·8	53·2	7·6	7, 7, 4	N, NW, NNW.	·061
„ 25	30·188	54·3	42·4	·66	·432	62·9	39·3	23·6	0, 10, 10	S by W, SW by W, —.	·000
„ 26	30·291	55·2	35·2	·50	·445	62·5	43·9	18·6	0, 6, 3	NNW, NNW, NW by N.	·000
„ 27	30·303	55·6	41·1	·61	·451	64·2	38·0	26·2	0, 10, 9	—, SW, S by E.	·000
„ 28	...	...	...	...	...	67·3	50·6	16·7	...	...	·000
„ 29	30·039	66·5	48·7	·55	·648	74·8	55·9	18·9	3, 1, 1	SW by W, S by W, —.	·000
„ 30	29·870	66·6	52·3	·62	·650	78·0	45·0	33·0	0, 0, 8	SSE, SW by S, S.	·000
„ 31	29·839	57·7	55·8	·94	·484	67·4	63·0	4·4	10, 10, 3	S, WSW, WSW.	·022
Monthly Means.	30·053	60·7	45·4	·61	·546	...	...	20·7	...	...	1·268

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—August, 1864.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour.																																
A.M. 12	16	4	3	5	4	6	2	10	8	9	9	8	3	5	5	9	4	6	1	2	2	4	14	9	1	3	1	6	8	2	13	5·9
1	16	3	4	6	6	5	1	10	11	7	12	3	2	2	5	6	3	6	2	2	2	5	19	9	1	7	1	4	11	2	16	6·1
2	18	3	2	6	6	4	1	11	8	9	9	2	0	1	4	6	7	2	1	3	1	3	18	6	2	3	1	4	9	3	14	5·4
3	9	4	3	3	5	3	2	12	11	10	3	1	1	0	8	4	10	5	1	5	0	2	17	5	4	1	1	6	9	3	17	5·3
4	8	4	1	5	3	3	2	14	7	10	5	0	0	1	6	3	10	4	2	5	1	4	19	7	3	4	1	7	7	3	17	5·4
5	6	5	2	5	7	2	2	14	6	12	8	1	0	0	4	1	13	3	2	7	2	7	16	7	2	3	2	4	8	4	18	5·6
6	11	7	2	4	6	5	4	14	12	15	6	2	0	0	2	2	16	4	2	9	2	4	18	9	4	5	2	6	10	4	20	6·7
7	11	11	2	6	6	5	3	15	10	15	6	1	1	5	5	1	16	4	1	10	0	8	18	15	4	10	1	14	10	8	25	8·0
8	12	12	3	7	5	7	5	15	12	17	10	4	1	4	10	6	16	5	2	9	7	11	16	12	2	10	0	16	10	10	28	9·1
9	8	13	3	9	7	6	7	16	11	19	9	5	1	6	10	7	15	7	6	10	8	11	19	16	4	12	3	19	12	12	22	10·1
10	12	11	5	12	7	4	7	17	4	18	10	5	6	8	12	6	15	7	9	9	3	15	20	15	4	14	3	17	12	17	21	10·5
11	13	11	6	12	10	8	10	15	8	17	11	7	9	7	15	7	13	8	10	6	8	16	17	17	5	12	5	17	12	19	19	11·3
12	15	10	5	12	13	10	10	15	14	16	10	4	7	8	13	8	14	7	9	7	4	18	13	15	5	11	6	19	11	21	13	11·1
P.M. 1	13	11	5	11	12	10	10	15	17	15	9	5	7	9	15	7	15	8	9	4	2	19	17	13	3	10	3	16	11	25	12	10·9
2	14	10	5	15	11	8	12	18	12	14	8	5	9	11	16	6	14	8	8	4	11	20	15	13	5	13	5	12	12	20	10	11·1
3	14	10	6	11	15	9	13	17	15	16	7	5	10	12	20	3	12	7	9	3	12	20	16	15	3	10	3	15	14	23	10	11·5
4	14	10	5	12	14	8	15	15	19	18	10	4	15	15	19	2	13	9	7	8	15	22	17	9	3	10	8	17	12	21	11	12·2
5	12	9	9	11	18	12	15	15	13	19	8	2	12	12	20	1	12	9	8	7	11	25	18	7	3	9	12	12	14	16	11	11·7
6	14	9	12	9	15	7	20	11	14	13	4	2	9	11	17	1	12	7	8	5	8	23	10	6	4	6	9	10	12	13	8	10·0
7	9	4	10	6	12	7	21	4	13	9	2	1	7	15	16	2	13	5	12	5	7	25	9	6	1	5	7	11	7	13	4	8·9
8	7	3	6	5	8	7	12	5	11	5	2	5	8	11	12	1	10	1	5	5	4	20	8	7	1	10	6	12	5	12	5	7·1
9	8	1	4	3	7	5	14	7	9	9	6	7	8	12	16	4	10	2	2	2	3	18	11	4	2	7	6	10	1	16	7	7·1
10	7	3	5	6	5	6	10	8	11	5	6	3	7	7	12	5	10	3	5	3	5	19	14	4	2	3	5	10	0	14	7	6·8
11	5	3	4	5	7	1	10	6	10	8	5	2	5	3	9	3	8	3	1	2	3	19	10	2	4	1	5	8	1	15	5	5·6
12																																
Total Daily Movement.	272	171	112	186	209	148	211	299	266	305	175	81	128	165	271	101	281	130	122	132	121	338	369	228	77	179	96	272	218	296	334	8·5

Inches.	Inches.
0·000	0·000
0·000	0·000
0·000	0·000

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1864.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2.30 P.M., and 5 P.M., respectively.		
			Calculated.								
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9.30 A.M.
	inches.	°	°		inch.	°	°	°			inches.
Sept. 1	30·036	58·8	45·7	·64	·502	68·4	47·0	21·4	4, 6, 7	SW, SW by S, SW.	0·105
„ 2	29·818	57·2	53·7	·89	·476	64·4	51·8	12·6	10, 10, 10	SW, SW, SSW.	·000
„ 3	29·682	58·8	53·3	·75	·502	69·7	50·4	19·3	3, 7, 10	—, WSW, SW.	·031
„ 4	...	...	...	...	...	67·8	51·6	16·2	...	... ...	·071
„ 5	29·987	58·1	41·4	·56	·491	65·7	54·3	11·4	6, 5, 4	W by S, W by N, W.	·059
„ 6	29·957	61·3	57·3	·88	·546	71·3	49·5	21·8	10, 9, 9	SW by W, WSW, WSW.	·173
„ 7	29·983	63·4	58·6	·85	·585	70·6	56·3	14·3	10, 10, 10	WNW, WNW, SW.	·010
„ 8	29·999	65·1	60·4	·86	·619	72·3	61·7	10·6	10, 9, 10	SW, W, SW.	·000
„ 9	29·905	61·7	58·7	·91	·553	67·8	62·6	5·2	10, 10, 10	SW, SW by W, SW.	·000
„ 10	29·957	55·2	46·5	·75	·445	62·6	52·3	10·3	10, 10, 7	—, SW, SSW.	·000
„ 11	...	...	...	...	...	60·8	48·8	12·0	...	... ...	·006
„ 12	30·016	54·6	38·5	·57	·436	63·1	39·7	23·4	5, 7, 7	W, NW by W, WNW.	·009
„ 13	29·908	55·1	41·1	·62	·444	60·8	58·4	2·4	8, 10, 9	SW, S by W, S by W.	·000
„ 14	29·590	57·1	53·4	·88	·475	64·4	51·5	12·9	9, 10, 10	S, S, SW by S.	·020
„ 15	29·604	57·0	49·4	·77	·473	64·2	46·2	18·0	7, 6, 4	SSE, SSW, SW.	·726
„ 16	29·342	55·7	48·7	·79	·453	62·2	52·8	9·4	7, 9, 6	S, SW, SW.	·254
„ 17	29·517	55·2	45·9	·73	·445	63·0	46·5	16·5	3, 2, 5	SW, S by W, S by W.	·520
„ 18	...	...	...	...	...	63·3	48·3	15·0	...	... ...	·209
„ 19	29·749	53·2	43·0	·70	·416	60·9	46·1	14·8	4, 2, 4	W, SW by S, SSW.	·040
„ 20	29·880	52·7	45·4	·78	·409	60·8	41·1	19·7	1, 9, 9	SE by S, —, SW.	·038
„ 21	29·787	56·6	47·0	·72	·467	64·3	52·4	11·9	0, 7, 3	NE by N, NE by N, SW.	·022
„ 22	29·792	58·2	50·0	·76	·492	65·6	52·4	13·2	7, 4, 0	SW by W, SW by S, SW.	·155
„ 23	30·054	56·1	46·6	·72	·459	63·7	47·3	16·4	2, 10, 2	WNW, SW by W, SW by S.	·004
„ 24	30·162	57·7	47·7	·71	·484	64·6	54·2	10·4	9, 2, 2	WNW, W, NW.	·021
„ 25	...	...	...	...	...	63·6	40·5	23·1	...	... ...	·020
„ 26	30·350	55·1	53·7	·95	·444	65·2	45·5	19·7	10, 3, 1	—, N by E, —.	·007
„ 27	30·256	56·8	47·3	·72	·470	65·8	44·6	21·2	0, 0, 0	E by N, E, ENE.	·000
„ 28	30·233	56·7	48·3	·75	·468	66·6	40·5	26·1	10, 0, 0	—, —, —.	·000
„ 29	30·133	56·1	47·6	·75	·459	64·6	42·3	22·3	0, 2, 2	NW by W, NW, NW.	·000
„ 30	30·136	51·6	47·5	·87	·394	59·0	46·9	12·1	8, 5, 9	NE, NE, —.	·000
Monthly Means.	29·917	57·1	49·0	·76	·477	...	...	15·4	...	... ...	2·500

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·057 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—Sept., 1864.

Day.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hourly Means.
Hour.																																
12		4	10	6	5	20	8	14	10	17	5	8	6	3	10	6	6	9	2	4	4	15	10	11	17	1	0	5	5	1	3	7·5
A.M. 1		6	11	4	6	18	5	14	15	16	5	11	5	5	10	4	9	5	7	3	3	15	7	9	18	1	2	3	3	4	4	7·6
2		3	8	5	4	15	7	11	12	19	3	10	5	4	7	4	12	4	7	4	3	10	8	8	18	2	0	4	4	3	2	6·9
3		6	10	4	4	14	7	11	13	18	3	8	5	2	8	4	12	5	3	4	5	8	9	7	16	1	1	5	4	3	4	6·8
4		6	8	4	4	11	3	10	14	18	2	7	5	3	8	3	12	8	8	1	3	12	6	10	18	0	2	6	4	3	3	6·7
5		6	12	3	5	13	3	9	14	23	4	9	5	5	10	2	20	5	10	2	4	5	5	7	16	1	1	8	1	4	3	7·2
6		5	13	3	5	10	6	9	15	24	1	11	3	3	12	1	23	5	9	5	3	8	1	7	17	1	1	11	1	3	1	7·2
7		8	19	5	6	15	11	8	15	20	4	9	5	5	15	4	22	8	11	7	4	9	4	9	12	2	0	9	3	4	5	8·6
8		11	19	6	11	12	10	10	19	24	2	15	7	7	22	9	20	14	11	6	3	8	10	9	13	1	1	14	2	5	9	10·3
9		16	18	6	15	17	8	10	17	25	3	15	5	13	23	13	15	20	16	8	3	12	9	11	11	5	4	15	2	8	10	11·8
10		21	20	8	14	16	10	10	20	23	5	12	10	15	27	14	17	22	16	10	7	12	8	12	14	5	2	18	3	8	12	13·0
11		18	20	9	11	17	15	12	20	29	2	15	11	14	26	14	17	15	16	9	7	10	11	10	11	7	4	19	4	7	10	13·0
12		16	20	10	15	20	15	10	16	28	4	15	9	15	29	14	18	12	15	9	7	11	16	13	12	6	2	16	5	9	11	13·3
P.M. 1		21	20	8	10	19	19	12	17	32	6	11	10	17	30	19	15	18	17	5	9	11	20	10	13	6	3	18	3	8	12	14·0
2		19	21	10	9	18	20	10	19	30	9	12	12	13	25	20	14	21	16	9	12	13	22	12	9	7	2	21	2	8	15	14·3
3		18	24	13	10	15	21	10	13	25	8	13	6	14	20	17	11	24	15	6	12	10	20	13	9	1	3	23	1	7	12	13·2
4		21	19	14	10	18	20	12	12	23	12	12	9	10	20	16	15	20	12	5	13	13	21	16	9	2	2	27	2	7	5	13·2
5		15	14	6	9	15	17	18	13	13	9	10	7	10	10	11	16	11	11	7	10	11	18	11	4	1	2	23	2	8	7	10·4
6		14	10	7	7	10	17	10	15	16	8	10	3	10	8	8	9	9	8	3	9	9	11	13	1	0	2	22	1	10	7	8·9
7		12	7	10	10	9	19	13	17	16	9	9	5	9	12	11	8	10	6	4	10	10	13	10	3	0	0	16	1	4	6	8·9
8		7	7	4	9	8	17	12	15	12	5	6	2	8	11	8	6	10	5	3	11	7	12	10	2	1	3	11	3	2	5	7·4
9		9	8	4	9	8	18	11	16	9	7	5	5	8	5	5	4	11	7	3	14	11	10	15	1	1	3	8	1	4	1	7·3
10		8	6	6	17	7	16	12	19	7	8	8	4	9	7	5	4	12	7	5	15	11	10	17	3	3	5	5	2	4	5	8·3
11		10	8	6	17	7	13	12	18	7	7	6	7	6	5	4	1	10	5	4	16	8	10	13	1	3	4	5	2	2	6	7·4
12																																
Total Daily Movement.		280	332	161	222	332	305	270	374	474	131	249	151	208	360	216	300	288	240	126	187	249	271	263	248	58	49	312	61	126	158	9·1

VEGETABLE MORTARS.

BY THE REV. M. J. BERKELEY, M.A., F.L.S.

(*With a Tinted Plate.*)

A GREAT deal has been written about the different methods employed in the vegetable world to insure the dispersion of seeds, and very marvellous a great many of them are. Amongst other means, a sort of explosion, as in the squirting cucumber and balsam, is not very uncommon; but perhaps no more curious instances occur than one or two amongst the smaller fungi, to which I beg leave to call attention in the present notice.

Some two or three years since, some excitement was produced in a large garden in Dumfriesshire, in consequence of everything in a particular hothouse being studded with little brown pellets, which adhered with great tenacity, and, indeed, could scarcely be removed without more or less injury. The under side of the leaves of plants of every kind seemed most affected; but not only living bodies were spotted, but the walls themselves, and, indeed, every object of what is sometimes called still life were pied with these little dark balls. Not the slightest conception was formed as to the cause, and an opinion seemed to prevail, half jest and half earnest, that the house was bewitched.

In this perplexity the case was submitted to me, and after a little pondering it struck me that it might arise from the growth of a quantity of little fungus, called *Sphærobolus stellatus*, which has the remarkable property of discharging its globose sporangium very much after the manner in which a shell is sent from a mortar. It seemed not improbable that if orchids were grown in the house, the white bog-moss (Sphagnum), which is often used in their cultivation, would be a very likely substance for the fungus to inhabit. Attention, therefore, was drawn in this direction, with a request that strict search might be made, and specimens transmitted to me, should anything be found. This request was complied with, and the result was a quantity of *Sphærobolus stellatus*, which sufficiently accounted for the apparent wonder. That the explanation, however, might not rest on mere conjecture, a portion of the fungus, properly moistened, was placed under a bell glass, the sides of which soon exhibited a quantity of sporangia, and there they remain closely attached to this very hour.

Some months later a case somewhat similar occurred at Ely. Every leaf, to whatever plant it might belong, within a

certain area was studded with little jet-black spots, as if some insect had deposited its excrement upon it, and, as in the former case, chips, plant-labels, and other lifeless bodies within the limits were similarly spotted. The first impression, on receiving specimens, was that I had to deal with some species of *Perisporium* unusually indifferent as to the matrix on which it grew. Instructed, however, by the experience of the former case, and informed that a thick coating of fresh dung had lately been spread over the surface, I fancied that the solution might be found in the generation of some explosive fungus in the dung, and further inquiry soon elicited that a species of Pilobolus was the head and front of the offence.

The extraordinary force with which these sporangia are discharged, and the distance in consequence to which they are sent, being quite equal, if we may compare small things with great, to that of a shell discharged from a small mortar, it may not be uninteresting to give some account of these fungi, and the more so, because I am not aware that the fructification of the first has hitherto been figured.

Sphærobolus stellatus,* though, perhaps, not very generally observed, as it is not very conspicuous unless fully expanded, is widely diffused, and is to be met with not unfrequently on soft decayed sticks in damp woods. It occurs also on all kinds of decayed vegetable substances in conservatories, provided they are not too moist or inclined to putrescence; but I have seen it nowhere in such abundance and perfection as on old heaps of sawdust about saw mills in Wales, where it sometimes occurs in sheets several feet in width. When unexpanded it looks like little grains of white mustard-seed partially covered with a delicate down, and more or less immersed in the matrix. These globular bodies, the outer coat of which consists of several concentric layers of cells differently arranged, some of which are colourless, and some tinted with orange, contain a tough hyaline lining membrane immediately surrounding the single globose sporangium. When all is ready, the outer coat splits nearly half-way down, into a few stellate divisions, and at the same time the lining membrane is inverted with such force as to shoot out the sporangium, the membrane itself adhering to the divisions of the peridium. The action is, in fact, precisely the same as that of a body tossed from a blanket held at the four corners. The disposition of the cellular tissue of the peridium will be seen from the subjoined figure. The sporangium itself consists of a dark outer coat immediately covering a mass of colourless cells, radiating towards the centre, the innermost of which, or at least a certain number of privileged individuals, produce at

* From σφαῖρα, a sphere, and βάλλω, I cast.

their tips the elliptic spores, exactly in the same manner as in *Nidularia* and its allied genera, as illustrated by Talasne.

In *Sphærobolus* there is but a single free sporangium, whereas in *Nidularia*, and its more immediate allies, there are several which are at first immersed in a transparent jelly, and attached to the walls by means of a highly elastic peduncle, sometimes of a complicated structure. These peduncles in wet weather are washed out, so that the sporangia hang over the edge of the cup-like peridium and at length become detached.

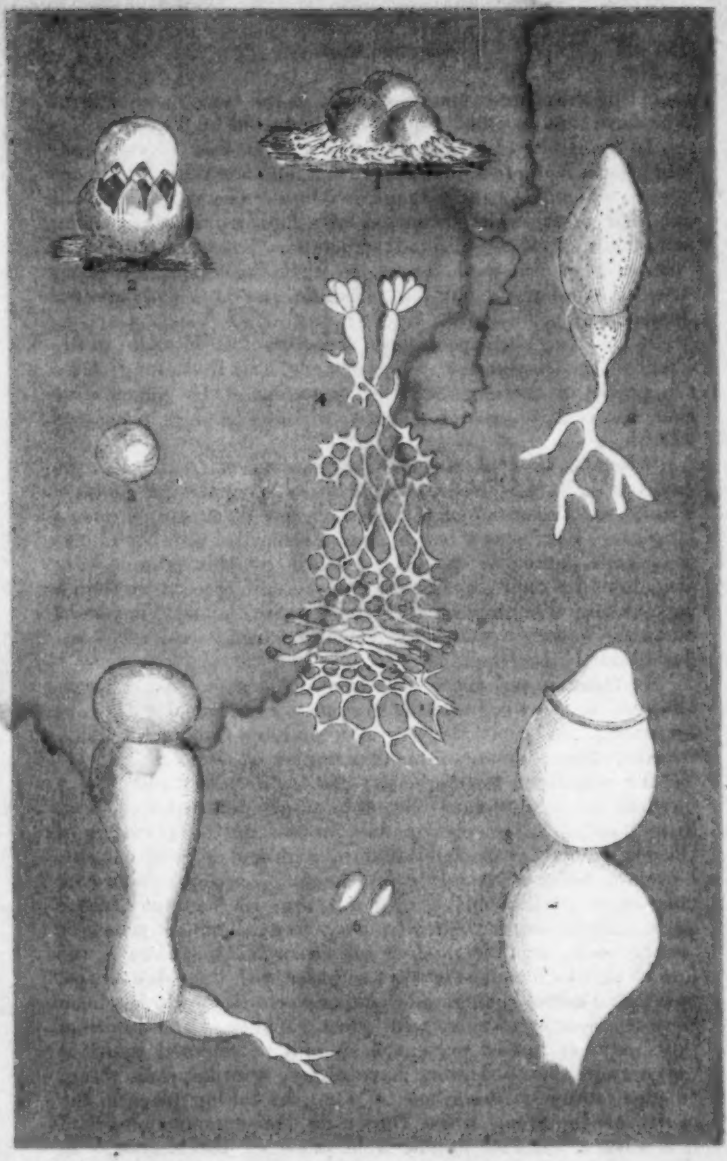
It has even been asserted in a communication made to the French Academy a few months since, that these fungi have the power of darting out their sporangia. The communication, however, does not amount to much, and is simply as follows:—

"Being, in 1846, at La Poussinière, a locality in the environs of Nantes, I met with beautiful specimens of *Cyathus striatus* on the trunk of a tree which had been prostrate for a long time, serving as a bench; and I remarked that the numerous little lenticular bodies produced by this fungus were suspended by their threads to the leaves of trees more than a metre above the fungi which had produced them. They were all on the lower surface of the leaves, and had evidently been darted out by the *Cyathus*."

As there is no mechanism by which this could have been effected, we must regard this account for the present as problematical. Without denying the author's facts, we may, without offence, demur to his explanation of them.

We now come to the second plant, *Pilobolus crystallinus*,* in which the explosion is effected in a very different way. This little plant is extremely common in autumn on the dung of various animals, especially that of pigs and horses. It has, however, been observed by Ferdinand Cohn, on a decayed mass of some species of *Oscillatoria*, a genus belonging to the Algæ. It is conspicuous frequently from its bright yellow or orange stem, and deep olive brown or black sporangia, the former of which almost always sparkles with little dew-drops, in which a minute elongated worm or worm-like body has been seen occasionally to move with great rapidity. The nature of this body has not at present been fully determined, and it is not certain that observers have always seen the same thing, for the motion is described by some as taking place in the cavity of the stem, while Durieu de Maisonneuve observed it in a colourless cell produced in place of the sporangium. Some think that it may have some important vital connection with the plant, but this does not seem very probable, and, as

* From πῖλος, a hat, and βάλλω, I cast.



VEGETABLE MORTARS.

Sphærobolus stellatus, fig. 1 to 5.
Pilobolus crystallinus, fig. 6 to 8.

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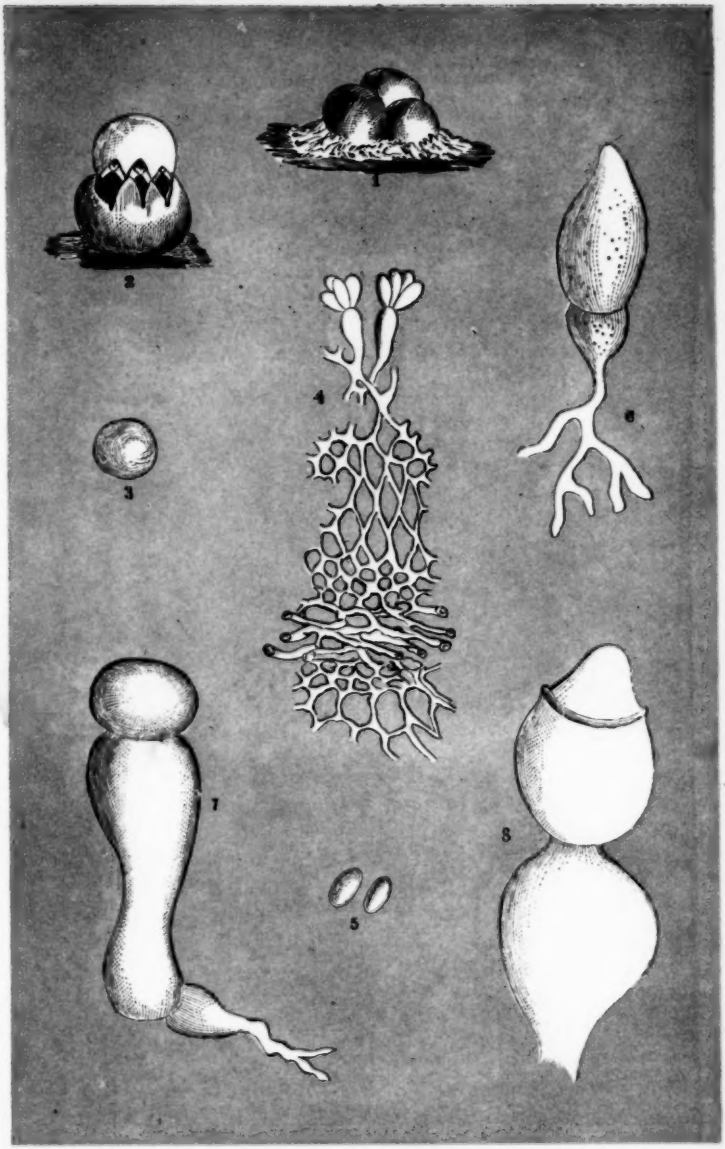

VEGETABLE MORTARS.

Sphærobolus stellatus, fig. 1 to 5.
Pilobolus crystallinus, fig. 6 to 8.

Dr. Johnson intimates, where we have nothing to say, it is better to say nothing.*

A branched thread which forms the root penetrates the matrix, the tip of which is elongated and swollen, and ultimately is divided by a transverse partition from the mother thread. The contents of this second joint circulate round the walls, leaving a cavity in the centre. The apex is gradually separated by a constriction from the lower part, and assumes a globular form with a dark tint, while the top of what is now the stem swells out like the hood of a cobra; a second partition is formed between the two, which gradually protrudes, pressing forcibly against the sporangium, and at the time when the spores are matured, the pressure from behind becomes so great, that the outer coat of the sporangium separates all round at the dissepiment, and the sporangium itself is ejected to a distance of several inches. Sometimes the partition collapses at the moment of explosion, and sometimes it protrudes permanently at the top, but it does not appear that a second sporangium is formed, as is the case with some of the *Saprolegniæ*, as was observed in the INTELLECTUAL OBSERVER, April, 1864. The outer coat of the peridium is of a deep black, and appears minutely granulated under a high power, and adheres readily to any object on which it may chance to impinge. The inner contains a compact mass of minute subglobose spores. These spores do not germinate very readily; but it is probable that, like those of the mushroom, and some allied Agarics, they require to pass through the stomach of some graminivorous or omnivorous animal to facilitate their germination. The vegetation of the plant is extremely rapid, the whole process being accomplished in about two days: the vegetative part, at least, is developed and disappears in the course of twenty-four hours. The affinities of the plant are very different from those of the *Sphærobolus*, and undoubtedly are with the true moulds (*Mucorini*, not *Mucedines*).

One or two species are assigned to either genus, but I have thought it necessary to refer only to the more common kind of each.

Fries has another genus, *Atractobolus*,† taken up from Tode, but it is very doubtful whether it be a fungus at all. What is commonly supposed to be the production is simply the egg of some mite of the genus *Rhipignathus*, the contents being taken for a sporangium. *Thelebolus*, which is placed

* The exact phrase occurs in a letter to Boswell, dated July 3, 1778, "You must not think me criminal or cold, if I say nothing when I have nothing to say;" which is to the same effect as the advice commonly said to have been given by Lord Brougham to Lord Campbell.

† From ἄτρακτος, a spindle, and βάλλω, I cast.

in the same group by Fries, is of very doubtful affinity, and at present does not seem to be well understood.

There are other fungi, however, which shoot out their fruit elastically, sometimes the whole fruit-bearing cell being ejected and sometimes the contents only. In the genus *Ascobolus*,* as the name implies, it is the asci, with their included sporidia, which are ejected, though only so far as to make the surface of the hymenium rough with projecting cells, as may very readily be seen with an ordinary pocket lens in *Ascobolus furfuraceus*, which is extremely common on cow-dung, and may be known by its greenish hue, while the sporidia themselves are of a bright amethyst blue, and form a beautiful object under the microscope.

In other cases it is the sporidia which are ejected. Many of our readers must have frequently observed, on handling one of the large orange-coloured *Peziza* which are such an ornament to our woods in autumn, or the washy brown kind which abounds on hot-beds in spring, a cloud of dust arise with a sudden jerk, and assume a kind of curve as if shot from a gun. This is composed of the sporidia, which are elastically ejected, the mechanism by which it is effected not being thoroughly understood. In *Sphæriæ* the process takes place as effectually, though in general not as suddenly, and Pringsheim† has shown that in *Sphæria Scirpi* a little circular aperture is formed at the tip of both membranes of the ascus, making way for the explosion of the sporidia one by one. This he believes arises from the pressure which the fluid contents of the ascus exercise on its elastic membrane, kept in a state of tension. In many fungi the mere contraction of the walls of the perithecium or peridium, as the case may be, effects the protrusion of the spores, which, if accompanied by a quantity of mucus, form tendrils at the mouth of the perithecium. In the higher fungi, as amongst many of the Mucedines, it is probable that one spore is pushed off by the formation of another behind, and if so it is very possible that this may take place with a force sufficient to assist in the dispersion of the spores. In a few cases the fructification is liberated only by decay, but this seems to be the exception rather than the rule.

DESCRIPTION OF THE FIGURES.

Fig. 1. Group of *Sphærobolus stellatus* before the rupture of the peridium, slightly magnified.

Fig. 2. A single peridium, more highly magnified, showing the inner peridium inverted, and attached to the tips of the laciniæ of the outer peridium.

* From *δεκάς*, a bladder, and *βάλλω*, I cast.

† *Jahrbucher für wissenschaftliche Botanik*, 1857, p. 192.

Fig. 3. Sporangium ejected, magnified.

Fig. 4. A thin horizontal section, highly magnified, through the plant just before the rupture of the peridium, showing the structure of the several coats, which do not always follow precisely in the same order, but are sometimes partially suppressed. Two of the sporophores are seen bearing the spores at their tips.

Fig. 5. Spores magnified.

Fig. 6. Young plant of *Pilobolus crystallinus*, magnified, showing the first and second cells, the former of which sends out rootlets below.

Fig. 7. A plant in which the third cell or sporangium is formed.

Fig. 8. A portion of the second cell which has thrown off the sporangium, showing the hilum and the protruding partition by means of which the explosion has taken place. The second cell in this case has a septum at the point of constriction. (These three figures are copied from Cohn.)

THE NORTH-WEST LUNAR LIMB (CONTINUED).—THE ACHROMATIC TELESCOPE.—OCCULTATION.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

We continue our examination of the districts adjacent to the NW. edge of the lunar disc. Our last objects were *Atlas* and *Hercules* (Nos. 4 and 5). In the region between them and *Geminus* (No. 2), *Franklin* (No. 6) may serve as a landmark, having a depth of 8700 feet under the W. end of the ring, and a considerable central hill; the breadth of the cavity being 33 miles. The interior shows but 2° of light in the full moon.

A great extent of surface, our guides remark, included between *Endymion*, *Atlas*, *Messala*, and *Franklin*, is almost exclusively occupied by forms which, on account of their boundaries, may be reckoned as ring-mountains of some importance, but, in other respects, can hardly be included in that class. Their interiors are not depressed, or darkened, or distinguished in any way from the external soil; take away the narrow wall, and no difference remains. The wall itself is usually irregular, open in places, destitute of peaks, and not remarkable for brightness. The inquiry whether these objects, which are not peculiar to this portion of the moon, can have been formed in the same way as the other ring-mountains, must indeed be left untouched; but it seems evident that if

the moon presented no other type, the idea of an eruptive force would scarcely have been entertained.

A very natural, though perfectly hopeless feeling of curiosity is sometimes expressed, as to what can be at the back of the moon, in that portion of her globe which is for ever hidden from mortal gaze; and it becomes in proportion interesting to ascertain what may exist upon the limb, and to watch the transition from the known to the unknown. If this does not always intimate the probability of perfect similarity (and there may be reason for believing that it does not *always*), in some instances it does so very distinctly; and such an instance comes before us on this NW. limb which we have been hitherto following, in the great plain lying immediately opposite to *Endymion*, and called

Mare Humboldtianum. Of this B. and M. claim the discovery; but it appears distinctly enough in the map of their contemporary,* Lohrmann; and there is some indication of it, though placed too far N., on the lunar globe of Russell. It is a grey level, exactly corresponding with the other "seas" in character, and extending upwards of 190 miles in length: the breadth is, of course, very difficult to ascertain, but it appears to be still greater, so that its area must be something more than half that of the *Mare Crisium*, and not far from that of the *Mare Vaporum*. In the most unfavourable circumstances of libration it is invisible, its nearer boundary falling upon the limb; in an opposite state the whole comes into view, and the lofty mountains at its back form the profile of the limb. These are of very considerable height—probably in one part not less than 16,000 feet; and in one place there is a gap, showing, perhaps, a communication opening to some more distant level. Its colour is evidently grey, though for reasons of perspective this is less decided in proportion to its nearness to the limb. B. and M. have given a separate plate of its most favourable projection in "Der Mond." Long low ridges alone are perceptible in its interior.

1863, Sept. 20, the Rev. H. C. Key, in examining the moon with a 12-inch glass speculum of his own workmanship, on which the silver film had not as yet been deposited, detected several extensive flattenings of the limb. Of some of these we shall have to speak more particularly at a future time; but it must be observed in this place, that in consequence of his information I looked for these curious objects on Sept. 23, and saw, besides two on the WSW. limb, two others in the region

* The dates of these modern Selenographies are as follows:—Lohrmann's map, from observations 1822-1836. His "Topographie," Part I. (all that ever appeared), 1824. First Quadrant of Beer and Mädler's Map, 1834. Their "Mond" (Moon), 1837.

which we have been describing, divided by a short, protuberant luminous ridge, which interrupted the limb at about an equal distance between *Struve* and *Endymion*. This happened 6d. 7h. before the greatest SW. libration. On the following night the appearance remained much the same, and the straightness of the outline in these two places was proved by the application of a micrometer thread to be no illusion: the flattening nearest the N. pole ended in that direction with a magnificent mountain, having its steepest slope facing N. This I thought must lie towards the N. end of the *Mare Humboldtianum*. 1864, Oct. 22, 4d. 21h. before greatest SW. libration, I saw one of these appearances very well again, cutting off the limb for 10° of arc, and ending with the same great peak. It seemed nearly to correspond with the position of the *M. Humboldtianum*. Oct. 26, 19h. before greatest SW. libration, this flattening had nearly disappeared.

I have not subsequently paid much attention to this curious phenomenon, but point out its general position, in the hope that some of my readers may be led to determine it more precisely. A careful examination of the limb, night after night, is sure at length to concur with the state of libration in which it is most perceptible. We have nothing analogous to it on the surface of the earth, unless a mountain chain exists anywhere in a position to show itself in profile upon the earth's limb, loftier at each end than in the centre, but so regularly curved, as we should think it, viewing it from the earth, that it would be straight as seen from the moon. For we must bear in mind the apparent paradox, that all that we consider straight, or level, on the surface of the earth, is really curved, in conformity with the figure of our globe; and that, therefore, a line really straight, or a surface really plane, would seem to us curved, lower in the centre than at either end (or on all sides). And it would be virtually so in effect; for, strange as it may seem, were a slice taken in a truly level direction from any part of the earth, since the centre of the flattened area would be nearer than the sides to the centre of the earth, gravity would be strongest at that point;—a pedestrian leaving it in any possible direction would have the impression of walking up-hill, a locomotive engine on a railway diametrically crossing it would run down there from either side, and all the water in the flattened space would collect and form a lake in the centre, whose surface would not be level, but convex. The lunar depression of which we speak cannot be a portion of the area of the *Mare Humboldtianum*, as that would follow the convexity of the globe; but its connection with the great level so named ought to be made out by observation.

THE ACHROMATIC TELESCOPE.

In a previous paper upon this subject it was explained that the defects of the old refracting telescope, with a single convex lens as an object-glass, were inherent and irremediable. To reduce their amount, therefore, as much as possible was the object of the ancient opticians. Theory and practice concurred in showing that they might be greatly diminished by contracting the aperture of the object-glass; that the intolerable imperfection, for instance, of a three-inch lens, with a focus of two feet, might be rendered almost insensible by "stopping down," or limiting, its aperture to three-fourths of an inch; but, as this would involve so great a loss of light that the instrument would be of little service in astronomical discovery, the only way of making this palliative really available was to reverse the process by preserving the aperture, but grinding the lens to a longer focus. It was thus found that the three inches would be brought to work well with a focal length extended to thirty feet; and in this way, with the increasing demands of astronomers for greater light and power, these instruments grew on and on till they reached such insufferably cumbrous and unwieldy dimensions that, even though their tubes had been discarded, they fairly broke down, as it were, by their own length, and gave way to the more portable and manageable reflector.

A still more convenient and generally-acceptable substitute would, however, in all probability, have been found but for a mistake, strange to say, of Sir Isaac Newton, the principal one perhaps that was ever made by that wonderful man. Although he had tried experiments on the refractive and dispersive powers of different media, the fact had escaped him—as it seems, through an unfortunate selection of materials—that, although the amount of dispersion always bears the same proportion to that of refraction *in the same substance*, this does not hold good in the case of different substances; and accordingly he concluded, and maintained his conclusion with a pertinacity which must be regretted, that in every possible case of refraction the separation into colour held the same fixed proportion to it, and that consequently "the improvement of telescopes of given lengths by refractions is desperate." This singular error retarded the invention of the achromatic telescope for about fifty-four years. It was not till 1729 that Chester More Hall, Esq., of More Hall, Essex, was led to the discovery of the principle by the study of the wonderful structure of the eye; and four years afterwards he completed an object-glass of 2½ inches aperture, with a focus of about twenty inches, an achievement which, had he thought fit to publish it, must have

caused as much surprise at the time, as we may now feel at its having been kept secret. A strange obscurity has veiled the name of a man whose inventive genius and mathematical acquirements must have been of no common order. His success was so completely unknown that the subject was taken up as an unexplored one, fourteen years afterwards, by the celebrated Euler, in a manner which excited the attention of John Dollond, a London optician, whose parents had quitted Normandy in consequence of the revocation of the Edict of Nantes. The mathematical abilities of this remarkable man enabled him to investigate the subject thoroughly, and the result was the re-discovery of the important fact that the amount of refraction being equal, that of dispersion varies according to the nature of the refracting medium. The application of this principle at once produced the achromatic telescope, which was secured by patent, notwithstanding some opposition on the ground of Hall's previous success, Lord Mansfield remarking that "it was not the person that locked up his invention in his scrutoire that ought to profit by a patent for such an invention, but he who brought it forth for the benefit of the public."

We have now only to premise that the property of a concave lens is the exact reverse of a convex one, producing a diverging instead of a converging pencil of rays, and we shall readily comprehend this truly ingenious construction.

There are two kinds of colourless glass, differing considerably in their optical qualities. These are Plate glass, the material of mirrors (which has replaced the greenish crown or window glass of the older opticians), and Flint glass, that used for drinking vessels, which contains a proportion of lead, whence arises its peculiar action upon light. Of these, when the refractions are equal, the flint has a considerably greater dispersive power. If, then, we were to combine a convex lens of plate with a concave of flint of equal focal length, though the rays would never come to a focus, passing through parallel, from equal refraction in opposite directions, there would still be a balance of dispersion on the side of the flint, and colour would be produced, which the plate would be unable to neutralize. Now, if we give more refractive power to the convex lens by shortening its focal length, we also increase the absolute amount of its dispersion; and by repeated trials we shall find it possible to make this dispersion the exact counterbalance of that of the flint lens, so that all colour shall disappear, while the shortened focus of the convex plate, preponderating over the unchanged divergent power of the concave flint, will cause the rays, instead of passing through both lenses parallel, to converge to a focus. In that point an image of external objects

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will be formed free from the inconvenience of coloured fringes, and thus we shall have constructed the object-glass of a telescope in which the imperfection arising from dispersion will exist no longer.

So far well. One defect has been exterminated; but what meanwhile has become of the other—the spherical aberration? It most fortunately happens that this error does not depend wholly upon the focal length, but (within certain limits) upon the form of the lens, and its amount changes with every change in the many combinations of curves corresponding to the same focal length. The aberration, for instance, of a lens of equal convexity on each face will be different from that of a plano-convex one of the same focus; and the latter again will be very different according as its plane or convex side is turned towards the incident rays; and the same holds good with concave lenses. Thus the circumstance of being obliged to combine two lenses to neutralize the error of colour renders it, remarkably enough, practicable to correct the spherical error at the same time, for we have only to make such a choice of curves as, without altering the focal lengths, will produce equal and opposite spherical aberrations in the two lenses, to reduce the defect to a minimum. And in this way a focal image will at last be produced free from both the imperfections so injurious to the performance of the ancient refractor, and our telescopes, with equal aperture, will not only admit of a wonderful reduction in length, but be actually more efficient, from the destruction of those errors which had only been palliated at the cost of so much inconvenience. Such is the beautiful theory of the achromatic telescope. How far it has failed in answering the full extent of expectation, with the causes and attempted remedies of that failure, will form the subject of some remarks upon another occasion.

OCCULTATION.

There will be only one occultation before midnight during the present month, on the 19th, when κ Cancri, 5 mag., will disappear from 11h. 27m. to 12h. 16m.

LOST IN THE BUSH.

BY THE "OLD BUSHMAN."

I REMEMBER once, when in Australia, reading the following advertisement in the columns of the *Argus*, "Lost, on the Dandenong Ranges, a little boy." And after a full description of his dress and person, and how he had strayed away from his party, who were pic-nicing in this wild but beautiful mountain range, a large reward was offered to any one who would restore the lad alive to his friends in Melbourne. I was camped at that time not far from the "Fern Tree Gully," near which place he was last seen alive, and although the whole of our party, as well as scores of others, who knew that bush well, scoured the whole country round for days and days in search of the missing boy, it was all in vain. We could never gain any tidings of his fate, which will probably now remain a mystery till that great day when all secrets shall be revealed.

Morning after morning that melancholy advertisement appeared in the columns of the daily paper, and day followed day of unsuccessful search, till at length we reluctantly gave it up, and returned to our wonted occupations. But it was long before the mournful impression created by that sad event wore away; especially as it was frequently renewed, when chance stock riders, on their way home to a distant station, would stop to light their pipes at our camp fire, and speculate on the probable fate of the lost child. The very blacks, who were familiar with every gorge and gully on this wild mountain range, and who had throughout assisted us bravely in our melancholy task, despaired, and "Piccaninny no come back. Tumble down, tumble down," was the usual greeting whenever I met one, for months after the sad event.

It is impossible to conjecture what were that poor lad's sufferings, but it is most probable that his strength soon gave way, and he was happily spared much agony and distress, which a strong man would have gone through in struggling manfully against his fate. But if the loss of this boy left such an impression upon the minds of strangers, it requires very little stretch of imagination to conceive the dreadful feelings of his parents, as day by day rolled on and brought no tidings of their lost son. What mental sufferings can compare with the "sickening anxiety of hope deferred"? And how often the mother's heart sank within her as each succeeding night and morning brought back the agonizing question of "Where is my child?" and Echo answered Where?

Lost in the Bush!—What a history of protracted sufferings,

what a chapter of fluctuating hopes and fears is conveyed in that short sentence. Of course we have no record of the last sufferings of the man who has perished by this, perhaps, one of the most lingering and dreadful deaths that can be well imagined. Few of us, however, who have wandered much over the trackless forests and plains of the Australian bush, have not, at one time or another, been lost, though happily, perhaps, not for long. And such men are familiar with the principal scenes of the first act in the sad drama. But I have talked with men who have been lost for days, and who were, by the merest accident, providentially snatched from the very jaws of death, when all hope of human aid had long vanished; and I never met with one who had passed through such an ordeal, who was not for ever after an altered man. We all know that in our daily intercourse with life, surrounded as we are with perils in every shape, the hurried escape from a sudden accident, which would assuredly have been fatal, is soon forgotten. But the case is far different when a man has to stare death in the face day after day, struggling on against hunger and thirst, fatigue and despair; buoyed up with, perhaps, the vain hope that at length relief must come, yet distracted with the horrid thought that his strength is fast failing, and when that is gone he has parted with the sheet anchor that alone holds him to this world. If such a man escapes to tell the tale, depend upon it we shall find that he has passed through a whole life of agony in those few days, the recollection of which can never entirely be obliterated from his mind. There is no excitement to sustain a man in such a position, no comrade to cheer him; he feels, as it were, cut off from all intercourse with the world. The gloomy forest, perhaps, stretches miles around him, but no human being is within call; or he strains his anxious eye over the burning plain without seeing one familiar landmark, and he knows his doom is sealed.

I have, more than once, been lost for days in the bush, but as I always had my gun, some matches, salt, and tobacco with me, it troubled me very little, and as long as my ammunition lasted I was just as well there as anywhere else; but I had one night in the Australian forest, which I shan't easily forget, when neither gun, matches, salt, or tobacco were of any avail, and which, next to my night in the snow, was, perhaps, about the longest and most dreary I ever spent in my life. It was the very night when the fiercest thunderstorm raged in our forest which had, perhaps, ever been known in Victoria; none of your effervescent storms which, perhaps, last for a couple of hours and pass over, but a downright cannonade of thunder and lightning for nearly ten hours, a thunder clap and a flash of

lightning about every five minutes (and such thunder and lightning as we can never hear or see far north of the Equator), accompanied at first with a rain which was perfectly deluging. I was at that time camped about twenty miles south of Melbourne, on the beach, not far from the Cannonade Creek, then a wild spot, little frequented, and close to a large swamp, at that day, perhaps, one of the very best places for duck in western parts. The station master gave me leave to live in an old hut, which I cobbled up with the aid of a few old bullock hides and tea-tree scrub, and made habitable; and although I certainly have lived in finer and better furnished rooms, I really do not believe I ever was more happy than in that old bush hut. At the time I mention, I was without a mate, and one afternoon, when coming home from a solitary ramble over the plains, I called upon a cockatoo settler, an old friend of mine, who had bought a paddock about three miles back in the forest, where I got my tea. The afternoon had been hot and sultry, the dogs could not work, the quail lay like stones, and a kind of oppressive stillness reigned over all, unbroken save by a low, distant, angry rumbling, which every now and then struck the ear. All betokened the coming tempest. "You'd better not get bushed to-night," said the station master, as he passed me on his road home, driving in some cattle; "for we shall have dirty weather before morning." "No fear, mate," was my reply, but it turned out a very random one.

It was pitch dark when I left my friend's house, and I had about three English miles of forest between me and my tent. A few drops of heavy rain now and then fell, but I fancied I should get home before the storm broke out. I kept down his paddock fence and came well into the forest. The night was so still that I could hear the sea come rolling in on the beach, so I had not the least difficulty in steering my course. I was walking on jolly enough, when all of a sudden, without the slightest warning, Bang! burst the thunder right over my head; such a peal, it seemed as if neither heaven or earth could have stood so sudden a concussion, followed by a flash of lightning, the like of which I had never seen before, but which I was fated to see more than once again on that night, and, without anything of a metaphor, the flood-gates of heaven did really open, for such a deluge of rain came down, that I could compare it to nothing except having a pail of water emptied on me. It was about nine o'clock; this deluge of rain lasted for at least an hour, without diminishing one drop, nor did the storm abate one bit of its violence till just before the sun rose, about five next morning. I tried to find my way back to the fence, but could not; the thunder crashed over my head, not a sudden clap, but a continued roar for nearly a minute, when

the blue lightning came hissing through the sky, and the whole forest would blaze up with light. There was something truly awful in the sudden pitchy darkness which would shut me in again in a moment after the flash died away. At first I was so stunned with the noise, frightened at the dreadful lightning, blinded and deluged with the rain, that I did not know what to do, but suddenly a flash of lightning, which seemed to play in rings down my gun barrel (and once before this has happened to me in Australia, without feeling the least shock), brought me to my senses. It would never do to carry my gun about in such a storm, and yet I dare not lay it down, for I knew I should never find it again, so I was puzzled how to act. My gun I must save at all risks. Yet my life (though at that moment it did not appear to be worth many minutes' purchase) was dearer than my gun. It luckily happened that a bush fire had swept over the forest a few days before, and many old logs and stumps (notwithstanding all the rain) were still burning. I saw one at a little distance, and close to it I placed my gun, and kept sentry over it the whole night. I don't know why I dare not sit down, but I got a notion into my head that I was safer if I walked about; and there I paced backwards and forwards, never losing sight of the one little spark in the forest gloom, which showed me where the only single treasure I at that time owned in the whole world lay. I have described the first clap of thunder, and the first flash of lightning, and I need not describe another, for they both continued the same without the least variation, at intervals of about five minutes, throughout the whole night. My position certainly was critical, for a large gum tree was struck with the lightning, and shivered from the top to the root, not very far from where I stood. I never, however, knew this till I went back with the station master the next day to see it. I certainly did recollect hearing one roll of thunder a little louder than the rest, and seeing a flash of lightning which appeared to come nearer down to me than any other, but the thunder and lightning came so simultaneously together, that the rattle of the thunder drowned all other noise. If ever I felt that I was perfectly helpless, and that my life was held in other and more powerful hands than my own, it was on this night. I was as nerveless as an infant, and paced up and down for hour after hour, expecting every one to be my last. But there was One who ruled even that storm, and it was His will that I was to escape the lightning which flashed all round me; but as if to show to me that the power, if not the will, to strike me dead in an instant was all there, one flash passed harmlessly over my head, but shivered a tree of 100 feet high into a thousand splinters close to me. But the storm at length died away, and before I left the forest the

sun had risen, and, strange to say, had risen without the usual morning greeting of the laughing jackass, whose shrill demoniacal cackle always ushers in the day in the Australian forest. I got home to my hut and found everything deluged with water. The sandy floor, by constant treading on it, had worn away about a foot below its original level, and the water stood in it like a little pond. My bed was thoroughly soaked, and worst of all my whole little stock of flour and sugar had melted into a kind of paste. I had a change of things under my pillow, but they were as wet as those I had on, so I hung them out in the sun to dry, and wet as it was I threw myself on to the bed, and I don't think I ever slept sounder, till I was awakened by the crack of a stock-whip outside the door, just about dinner-time. It was the station master, whom I had met on the plains the night before. It did not take him twice to repeat his order of "Here, come home with me, and get some salt beef and damper." And on the road to the station he told me about the shivered gum, which we went to see after dinner, and which had stood little more than 100 yards from the smouldering log where I had laid my gun. I carried home a splinter of the old tree as a kind of "*memento mori*," it now lies on my table, and I believe it was the sight of this very bit of wood which dictated this my first introduction to the readers of the INTELLECTUAL OBSERVER.

EXPERIMENTS IN CRYSTALLIZATION.

A PAPER on *Crystallogenic Force*, recently read by M. Fred. Kuhlmann before the French Academy, suggests many elegant experiments which our readers can easily perform. When conducted on a large scale, with suitable materials, they will give rise to beautiful plates or panels that may be used in ornamentation, while on a small scale they will furnish interesting microscopic objects.

Some years ago the *moirée metallique*, or crystallization of the tin on common tin plate, was frequently resorted to for decorative purposes; and M. Kuhlmann points out how the patterns may be varied; but his directions are the same as those given long ago in English works—as, for example, by Brande in his *Manual of Chemistry*. This tin plate should be well cleaned by washing with a little caustic potash, well rinsing in plain water, and then drying. If a plate so prepared is slightly heated, and then quickly washed over with a preparation composed of two parts of nitric, and three of hydrochloric

acid, and eight parts of water, beautiful large groups of crystals will appear. The acid should not be allowed to remain in contact with the metal, but quickly washed off with water. Dark spots may be generally removed with a little caustic potash.

By sprinkling the surface of the heated tin with cold water, or by acting upon portions of the surface with the blowpipe, great variations in the pattern may be obtained. As M. Kuhlmann states, any point touched by a cold water drop becomes the centre of a crystalline pattern, the rays from which proceed until they are arrested by similar rays proceeding from other centres. The lustre of these patterns may be preserved by a coat of transparent varnish. M. Kuhlmann considers that the variations which these crystals present from the normal crystallization of tin, result from the action of the iron in the tin plate, which offers certain obstacles to the crystalline force.

There is, to our apprehension, very little originality in M. Kuhlmann's remarks, as experimenters have long recognized the effects of substances which modify the power and direction of crystalline forces; but though we see no novelty in his philosophy, we may borrow some of his illustrations, with thanks for their suggestion. He tells us that, if we remove all grease from a plate of metal or glass by means of potash, and then wash it over very lightly with a solution of mannite, we shall obtain, as it evaporates, a pattern composed of stars, separated from each other by straight lines at equal distances from the centres of radiation. The solution of mannite must not be too strong.

By covering a clean glass plate with strong solution of sugar, he obtained a varnish which did not alter after several days exposure to dry air; but which, being left for one day in a damp cellar, exhibited a new appearance, the sugar having arranged itself in groups of crystals, leaving blank and uncovered interspaces on the glass. In this case the moisture had given sufficient mobility to the sugar particles to permit their arrangement by the crystalline force.

On covering clean plates of glass or metal with solutions of sulphates of iron, copper, zinc, and many other substances, vacant spaces were left when the crystallization was free; but if the mobility of the particles was lessened by the presence of metallic oxydes, alumina, or magnesia, or by any gummy, gelatinous, or albuminoid substance, the crystals extended over the whole surface occupied by the solution, and beautiful effects in the shape of stars, garlands, etc., were produced.

M. Kuhlmann says that all viscid substances, such as gums, dextrine, albumen, gelatine (sugar, and glycerine ex-

cepted), afforded good results; and in many cases he obtained imitations of appearances observed in such minerals as arragonite, gypsum, etc.

Experiments of this kind present no difficulty either of manipulation or expense, and it is very instructive to compare normal crystals with those obtained when any viscid material, or special arrangement of temperature, interferes with the patterns which the crystalline force makes when its operations are unimpeded.

THE PRODUCTION AND WASTE OF MONEY.

BY JOSEPH NEWTON.

In a great commercial community, like that of England, there cannot fail to exist a considerable amount of interest in everything which has reference to the currency in use. Not only is this so in a moral and social sense, but also in a material one. The quantity, purity, and durability of gold and silver coinages are questions of much importance, and which have accordingly engaged the attention of monarchs and legislators from the earliest periods. As regards the quantity of money circulating among the people of this country, that has necessarily varied exceedingly at different epochs and even in different reigns. Owing, however, to the enormous increase of traffic which has followed the introduction of the railway system, the steady development of manufacturing industry, resulting from the employment of steam-power, and the yearly augmentation of the population of the British Isles, there was never at any former period so large an amount of metallic money required, or in existence as at present.

It is a remarkable fact that scarcely any serious alterations have been made in the purity of English coins of gold or silver for many centuries.

When Henry III. introduced gold coin into our mints, the metal of which they were composed was that known as twenty-four carat, or pure gold, without a particle of alloy. So it remained until Edward III. ordered a reduction of the standard to twenty-three carat three and a half grains fine gold, and half a grain of alloy. It remained for Henry VIII. to take further liberties with the gold coinage, and this he did unsparingly. He debased it to twenty carats, with the exception of a certain small coinage of crowns of gold, which were com-

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posed of twenty-two carat metal, that is twenty-two parts of gold to two of alloy, and which mixture thenceforth took the name of crown gold. In the reign of Charles II. this latter rate of purity was made what it has continued to be up to this hour—the sole standard of all the gold coins of the realm. It will thus be seen that in spite of the nefarious proceedings of Henry VIII. in regard to the gold coinage during the last twenty years of his reign, the mutations of purity it has undergone are inconsiderable; and coming to the silver coinage, it is a striking circumstance that for nearly seven hundred years —again excepting some tamperings of the monarch just named—its standard of purity has remained unaltered. For example, the silver coins of Henry II. were composed of a mixture consisting of eleven ounces and two pennyweights of fine silver, and eighteen pennyweights of alloy. Those of her Majesty, Queen Victoria, are of precisely the same degree of fineness, and it is not at all probable that for centuries to come, the standards of either our gold or our silver coins will be interfered with. In both cases we have obtained compositions —the alloy used being the purest copper—which give hardness and beauty of appearance to the individual pieces of money resulting from them—and these are desiderata, the importance of which is sufficiently obvious. Of the subordinate and inferior currency it may be said that from the year 1672 (*temp.* Charles II.)* to the year 1860, when the present bronze coinage was inaugurated, it has been composed of copper. There is no doubt about the superiority of bronze over copper for the purpose of conversion into coin, although the mechanical difficulties attending the operation are certainly much greater. The addition of four per cent. of tin and one per cent. of zinc has the effect of hardening the remaining ninety-five per cent. of copper to an extent which is incredible to any but those who have witnessed the labour of rolling and stamping the compound, and which illustrates the fact that the ancients used bronze for cutting implements before steel had become known.

Thus much for the materials of which the British coinage is composed. Let us now turn to a consideration of the quantity of each denomination of coin actually circulating in Great Britain, and the rate at which it deteriorates, or wastes by abrasion and friction. It will be well to commence our inquiries with the year 1816, because, during that and the year following, the whole of the silver monies of the realm were recoined, and because all the gold coins, save those preserved

* A small coinage of tin by way of experiment was struck in 1684 by the same monarch. This was deemed a failure, as were those of pewter and gun-metal struck by James II. and abandoned.

in collections or museums, of a date anterior have long since found their way back to the crucibles of the Mint, or else been cast into American Eagles and French Napoleons.

It appears, then, from official statements annually made to the House of Commons, that there have been struck and issued from the British Mint since the period named, and up to the present moment—

Double Sovereigns . . .	16,119
Sovereigns	146,071,897
Half-Sovereigns	26,592,903
Total	172,680,919

By far the largest proportion of the two last-named denominations of money—the double sovereign* having, unfortunately, become obsolete—were coined during the reign of her Majesty. The years 1853 and 1855 were indeed pre-eminently fruitful. In the first no less than eleven millions nine hundred and fifty-two thousands and ninety one pounds sterling, in sovereigns and half-sovereigns, were pressed into being; and in the second, 1855, nearly ten millions sterling came forth from the Mint in the shape of gold coins. The united productions of those two years therefore give a grand total equal to more than one-eighth of the entire gold coinages of the whole forty-seven years in question!

Taking into account the continuous influx of light gold to the Bank of England, and its subsequent relegation to the Royal Mint for re-coinage, together with the not less constant efflux of gold coin to the Continent, and to other and more distant parts of the world, as India and Australia, it may be safely calculated that the absolute circulation of gold money remaining at home amounts in value to one hundred and twenty millions sterling. Allowing, now, the population of the British Isles to be thirty millions, it is plain that, equally distributed among the Queen's lieges, the gold coinage is sufficient to supply each inhabitant, young and old, with the sum of four pounds sterling! The total weight of the most precious metal thus absorbed is in round numbers not less than twelve hundred tons.

Of the silver coinage of the realm, it appears, by the indisputable testimony of official returns, and from evidence furnished by Professor Graham, Master of the Mint, in 1859, that there were then in circulation among the subjects of Queen Victoria:—

* This coin might well be reproduced under the name of the "Victoria." It is well proportioned, and would be found highly useful.

Crowns.	2,320,027
Half-Crowns.	37,516,343
Florins.	10,000,000
Shillings	112,554,106
Sixpences.	76,132,578
Fourpences	20,142,034
Threepences.	7,572,437
Total	266,237,525

To this list there have been added since 1859, and up to the close of 1863—

Florins	2,069,100
Shillings	4,007,520
Sixpences.	2,692,800
Threepences	7,870,104
Total	16,639,524

and forming an aggregate of two hundred and eighty-two millions eight hundred and seventy-seven thousands and forty-nine silver coins existing in the banking houses, tills, purses, and pockets of the inhabitants of the United Kingdom! The coinage of crowns, half-crowns, and fourpences has been suspended for several years past, and it is a question for the legislature to decide as to whether that coinage shall be resumed. No doubt the half-crown is a very serviceable piece of money, and it has accordingly many friends—notedly, Lord Overstone among them. The advocates of a decimal system of currency, among whom is the writer of this paper, of course disapprove of it, and desire that it should be cast into the melting-pot. Certainly in companionship with the florin, the half-crown is an awkward specimen of mintage. Reverting next to the subordinate coinage, that of bronze, and we find that since its introduction, at the beginning of the year 1860, there have been issued to the public, partly from the Mint, but principally from the presses of contractors in Birmingham—James Watt and Company—the following quantities of each denomination:—

Pence	92,000,000
Half-pence	130,000,000
Farthings	25,000,000
Total	247,000,000

From the foregoing statistics, which approach very nearly to the truth, though the Mint is each day engaged in adding to

the sums total, it may be gathered that the coins of all denominations now doing duty in, and facilitating the trade, traffic, and commerce of the country—leaving the colonies, most of which have distinctive coinages, out of consideration—numbers not less than six hundred and fifty millions. This, too, is irrespective of the old copper coinage, considerable portions of which still circulate in remote districts of Ireland and Scotland, and in some parts of England.

We may now touch upon the concluding division of our subject, namely, that which relates to the speed at which the deterioration of the coinage goes on by force of wear and tear. Everybody has heard of "waste of money," resulting from extravagance in a national, as well as in an individual sense, but that there is another way in which money is wasted will be presently shown. This, in truth, is a literal waste of money, whilst that is simply a misuse of the circulating medium—a diversion of it from its legitimate and proper purposes.

From the moment that a newly-struck coin passes from the Mint or the Bank with the bloom and lustre which the highly-polished dies have given it, its deterioration commences. The constant friction between loose pieces of money carried in the pocket finally produces the effect of removing altogether their engraved surfaces, whilst the serrated edges of gold and silver coins, originally devised to prevent clipping, act upon each other like files, and hasten the wasting process. If coins of different dates are weighed, it will be found that they have suffered a diminution in proportion to their respective ages, although the first three months of their existence are usually the most destructive. At first the fine and sharp lines and angles, left as outlines to the devices, and upon which the artist has devoted in the die so much care and skill, disappear, then the legends, dates, and superscriptions grow faint, and eventually the uniformity of flat surfaces, entirely destitute of Mint marks, is attained. The smaller the coins, the more rapid their deterioration. This arises probably from the more active circulation to which, as a rule, they are exposed.

If, after the disappearance of the obverse and reverse impressions of a genuine coin, it be heated to redness, the apparently obliterated devices will again show themselves, and this with some distinctness. The cause of this rather singular circumstance is less obvious than the effect. It is due to the fact that in all struck coins the figures ornamenting them have been produced by the necessary inequalities of the surfaces of the dies, and hence certain parts of the coin are more compressed than others. Take the sovereign as an illustration. When the plain disc of gold intended for stamping is placed on the die, it is as soft and plastic

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as fire and water, judiciously applied, can make it. Then, when a blow is administered to it by the rapid descent of the second die, the plain portions of both dies sink deeply into the softened metal, in order that the engraved devices may be perfectly filled. The operation of stamping, therefore, is not so much a raising of the impressions as it is a depression of certain parts of the gold surfaces, in order that other parts of those surfaces may reach the depths of the engraving on the dies. The amount of force administered is regulated by the boldness which the engraver intends the devices to assume. It will be clear, then, that the most prominent parts of a coin are those which have undergone the least amount of compression—an unfortunate contingency, because those very parts remain soft, while, by and bye, they will be most exposed to the action of abrasion. Allowing that the sovereign, to which we have just referred, and which may be taken, in its mode of manufacture, as an illustration of all coins, has been long enough in circulation to have lost its impressions, the application of great heat will, to a certain extent, restore them. The severely pressed surfaces will be expanded, and the outlines at least of the devices will, in a ghost-like form, reappear. It is thus that old and worn coins may be made to tell the story of their birth, although time and hard work have done their best to conceal it.

Now arises the question of, "What becomes of the worn-off impressions of gold and silver coins?" The precious metals we know are indestructible, and undoubtedly the particles of metal abraded from their surfaces exist—somewhere. They cannot be annihilated. In reference to the fact of the imperishable nature of gold, it has been suggested that a portion of that now in use in the form of coin, or trinkets, may have once entered into the composition of the Cherubim of the Holy Temple, or constituted part of the 120 talents which the Queen of Sheba presented to the wisest of men! Such a thing is certainly not beyond the pale of possibility, but it is not intended to pursue such an inquiry at present. It might be curious to do so, but its profitable issue would be at least dubious. The House of Commons acknowledges the fact of the loss of silver by abrasion of the coinage, for it votes annually to the Mint authorities a sum of £10,000 to the Mint for the purchase of worn silver coins, and as these are always received from the Bank of England at the nominal value at which they have been paid into it, the loss to the nation on each transaction is considerable. Of course we all assist in deteriorating the coinage, and it is but fair that we should all share in the expense of renewing it. Those who are in the habit of carrying coins loosely in their pockets inflict the heaviest amount of punish-

ment upon them, whilst the users of *portemonnaies*, by diminishing the effects of friction, add to the longevity of the metallic currency. Whether the present Chancellor of the Exchequer by an ingenious adjustment of taxation may be able to "adjust the burden" fairly upon the shoulders of money destroyers and money preservers, is a question for that able financier's consideration.

Cheap travelling is a source of destruction, or at least of rapid deterioration, to coins. People move about now much more frequently than in former days, and so does money. Whether the former wear out sooner in consequence is a problem for social economists, but that the latter does is certain. The celebrated Mr. Jacob estimated, many years ago, that the loss of metal annually by the abrasion of the coinage equalled one part in every three hundred and sixty, and as he supposed that there was in existence in the world, in 1810, about £360,000,000 in the shape of coin, the total sum wasted every year was exactly one million sterling!

It has been calculated, and deduced from actual experiments, that the deterioration of ten-year-old silver coins is as follows:—crowns, 5 per cent.; half-crowns, 12 per cent.; shillings, 30 per cent.; sixpences, 40 per cent.; and threepences, 42 per cent. So far as the two last denominations are concerned it may be said that at ten years of age they are worn out. In respect of the bronze coinage sufficient time has not elapsed since its creation to enable us to give data as to its durability, though, as has been said, the extreme hardness of the metal is much in its favour.

The gold coinage does not deteriorate in anything like the ratio at which that of silver wastes. It rests indeed on a totally different basis; it is not subjected to such rude treatment; it moves in higher and more circumscribed circles, is only a legal tender when of legal weight, and is preserved with more care under the *portemonnaie* system. It is no uncommon thing to find sovereigns in circulation of the date to which reference was first made in this paper, and which are within the "remedy," allowed by law. The same law however exists in reference to the early life of this coin, which governs that of all others. It wastes when very young much more quickly than when old.

One remark or two, of a mechanical character, as to the means of promoting the durability of coins, and we have done. They should all be provided at the Mint with deep and broad protecting edges. This is a point of the highest importance, and which if properly observed would add materially to the length of their lives. In all cases those edges, which form as it were the frames to the metallic pictures, should stand out with sufficient prominence to guard

those pictures from abrasion on counters and tables. By attention to this, and by adopting the flat style of engraving—clear in outline but not bold in relief—economy, elegance, and greater durability would inevitably characterise the British coinage. It should always be remembered that coins are intended to do the work of coins, and that they ought not to resemble medallets, as too many of them at present do.

POWELL AND LEALAND'S $\frac{1}{50}$TH.

The question of the use of high powers for the microscope is rising in importance, and the argument is certainly in favour of those who desire to obtain the greatest magnification consistent with distinct vision, and convenience in use. The relative merits of twelfths and twenty-fifths must be considered upon the principles by which we estimate the comparative advantages of eighths and twelfths, while the twenty-fifths will have to be tested by comparison with the fiftieths, or any higher power that can be got into working order.

It is not desirable, when the *finest* definition is required, that the power of any glass should be pushed indefinitely beyond that which it will give with the first eye-piece usually employed. With high powers, if more than double, or at the outside triple, the enlargement produced by the employment of the first eye-piece is required, it is usually much better to resort to a deeper objective than to a deeper eye-piece. The chief exceptions to this rule arise from the fact that, the deeper objective must be brought considerably nearer the object, while the focussing of a lower objective with a deeper eye-piece is little changed.

It is of no use to magnify an object more than is necessary for its convenient display, and consequently it is only those which are extremely minute that can be benefited by greater enlargement than a good $\frac{1}{12}$th will give. Suppose the performance of such a glass to be in perfection when not pushed beyond 1500, a $\frac{1}{25}$th should be quite as perfect at 1000 more, and a new $\frac{1}{50}$th just made by Messrs. Powell and Lealand is exquisitely perfect when acting upon the Podura scale at 4000. All the glasses we have named perform *well* at considerably higher powers than we have named. It is hard to choose between Ross's $\frac{1}{12}$th and Powell's $\frac{1}{25}$th at 2000, though we think at that range the latter has the advantage. It will be hard, we apprehend, to choose between Powell's $\frac{1}{25}$th and their $\frac{1}{50}$th at 3000 or 4000, though we expect the latter will have a slight

advantage at the higher figure. The $\frac{1}{25}$th gives a good view of an object up to 9000,—so say some of its most experienced possessors, and from what we saw of the $\frac{1}{50}$th, we have no doubt its capacities will prove equally extensive. Pushed to their extremes, fine glasses may often furnish some unexpected information, but their choicest and most reliable work will be far below their utmost range. The physiological inquiries conducted by Dr. Beale show that very great enlargement is necessary in order to trace the minuter nerve-threads, and see how they stand in relation to nerve-cells. The vibrions are not likely to yield the secrets of their organization to any ordinary powers, and some of their family are scarcely visible when magnified 2000 times. Great interest is felt to discover how structures begin; whether by liquid matter solidifying, or whether some small solid molecules are present at the commencement, and by their coalescence form tissues and organs. A glance at the protoplasmic fluid circulating in the *Anacharis*, or the *Valisneria*, when viewed with a magnification of 2000 linear, will serve to reveal a multitude of minute bodies, whose proceedings and origin we should like to be acquainted with, and if we are to gain such information, extreme magnification, with exquisite definition is our only chance.

Messrs. Powell and Lealand have shown that a $\frac{1}{50}$th can be made to define minute objects as perfectly as an inch glass deals with large ones, and the new objective works through glass about ·003 thick. This is very good, and we do not doubt it will be found useful in able hands, although nothing short of a series of careful experiments can show when and where it is superior to the $\frac{1}{25}$th.

We must, in discussing these high powers, again revert to the importance of increasing their penetration and focal distance to the utmost limits which optical skill can devise. The extent to which this can be carried will very much depend on the material the glass maker can provide. If he can go on increasing the density and refractive power of glass, a new era in optical science will arise. Meanwhile it is a matter of optical formula, and the distance at which Smith and Beck's $\frac{1}{25}$th will focus, shows what can already be done.

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A BALCONY OBSERVATORY.

BY HENRY J. SLACK, F.G.S.

Among the numerous readers of the Intellectual Observer who desire to become familiar with the various interesting celestial objects within the reach of small telescopes, many must have experienced the inconvenience of either looking out of a window, or carrying their instrument into a garden every time an observation has to be made. Some will have the means of constructing a regular observatory, and will no doubt profit by the instruction conveyed in the papers of Mr. Bird and the Rev. W. Berthon. A more numerous section will, like myself, have to devise other arrangements, and it may interest them to know what I have done.

My best place for observation was on a level with one of the windows of my drawing-room, in a situation commanding a view extending from N.E. to S.W. The length of my own garden, together with a road, and the gardens of neighbours opposite, gave me a deeper space than is common so near London, and the width of my look-out was still better, as being less interrupted by buildings or trees. My object was to utilize this situation for star-gazing purposes, without offending the taste of the household gods by any unsightly erection. My telescope—having a fine three-inch glass, by Steinheil, upon Gauss's principle—required about seven feet to be manipulated comfortably, when a dew cap was at one end and an observer at the other. I therefore devised an observatory seven feet square, opening from the drawing-room by French windows, and glazed all round. Two iron columns and a light iron girder, erected in the garden, support at one end two slabs of stone three inches thick and a few inches wider than the internal dimensions of the room. The other ends of the stone slabs are carried into the brickwork of the house. The two stones were deeply grooved where they joined in the middle, and fastened firmly together by running in lead. Upon these stones, woodwork was fixed nine inches high, on the top of which are two grooves, one inner and one outer, with flat iron rails on which the sashes slide.

The top framework of this balcony observatory was made something like the headpiece of an Arabian bedstead. It is supported by two strong uprights close to the wall, and by the framework of two fixed sashes three feet six inches wide. No advantage would have been gained by making these sashes to open, as the telescope was placed just in advance of them, so as to command all the lateral

view which adjacent houses permitted. The top frame was further strengthened by a bar of iron let into it, carried through to the wall, and well secured by a nut inside, and just below the floor of the room above. The front part of this frame, seven feet wide, projects three feet six inches beyond the fixed sashes, and all round it there are grooves to receive the tops of the moveable sashes. The top of the framework is nine feet six inches from the floor.

The moveable sashes are six in number. Two are three feet six inches wide, one at each side, and capable of sliding back to their full extent. The front sashes, of which there are four, are of two sizes. The two larger ones, twenty-six inches in width, occupy the centre, and slide in the inner groove. The two smaller, nineteen inches in width, occupy the two ends, and slide in the *outer* groove. The result of this arrangement is, that every portion of the seven feet space in front, and of the two three-and-a-half spaces at the sides, can be uncovered by sliding the sashes. If the front sashes had been of one size this could not have been accomplished. A light iron railing, fixed to the stone outside the observatory, renders it safe when the sashes are open.

The top framework slopes from the house wall outwards and downwards. A fixed roof of wood, protected with zinc, covers the half next the house; but the front half—three feet six deep and seven feet wide—runs on rollers and an iron rail, so that it can be drawn up *inside* the fixed roof. By attaching rollers to the side edges of this moveable roof, as well as to that portion of its under-surface which lies above the rails, it is easy to pull it up steadily by *one* cord working over a block. Any tendency to shift it on one side is counteracted by the side rollers, and the motion is easy and smooth. Attached to the end of this cord is a sash-weight (13 lbs.), which is covered up with American leather-cloth for the sake of neatness. By pulling at this weight, a slight force raises the roof, and it stops wherever it is put. When it is to *descend*, the weight is raised, and the roof falls down the inclined plane of its own accord. Thus I get a half-circle in azimuth, and a zenith view. I lose the little bit of sky which the framework conceals, and have sometimes to wait till an object has passed it. This might have easily been avoided by arrangements adapted to other situations; but in my case it was the condition on which I could construct a balcony observatory that was a pretty object from the drawing room, and a pleasant addition to it. A solid plaster pedestal, painted to imitate red granite, supports one of Horne and Thornthwaite's equatoreal stands, and an ornamental Manilla hemp matting covers the floor. As my house is a quiet one, I find this arrangement very steady. I

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can, for example, divide the four stars of ε Lyræ *clearly* with less than 100.

The advantage of having a telescope always ready is very great, and I have seen many objects from my balcony observatory which I should have assuredly missed without it. For example, on a cloudy, uncertain night, with so few lucid intervals that I should certainly not have mounted a telescope specially for the purpose, I had a fair view of one of the lunar curiosities—the rectangular formation, near Fontenelle, concerning which Mr. Webb will no doubt discourse in due season. This strange object is, when seen so that the varying height of the walls cannot be noticed, just like a field fenced in with the stone walls common in many parts of England. Its size (60 miles long), and the height of the walls, from 250 to 3200 feet, precludes the notion that it is an artificial fence surrounding a Selenian park or farm. Were it not for this consideration we should be tempted to look upon it as a specimen of the constructive skill displayed by the "Man in the Moon." I saw it on the 9th October from 8 to 9·30 p.m., the new moon having occurred on the 30th September at 10·43 p.m.

Many other instances might be mentioned, of catching views that would not wait, and I strongly recommend those who have a suitable place, to construct a balcony observatory, if they cannot do better. It would give me decided satisfaction if I could say that my work cost as little Mr. Berthon's; but as it requires careful fitting in every part, this could not be expected. It may enable married observers to obtain feminine consent to such an addition to a sitting-room, if I mention that a few handsome plants can be placed in positions that do not interfere with astronomical uses. I would also recommend that, in the absence of a sidereal clock, a good watch should be regulated to keep sidereal time, as suggested by Admiral Smyth.

BEE-KEEPING, BY "THE TIMES'" BEE MASTER.*

THE publication of a book by a writer who announces himself as connected with the *Times* newspaper, is certain to attract a considerable amount of attention, wholly irrespective of the merits or even of the subject of the work. We therefore feel called upon to devote a far greater amount of space to a notice of this volume, than we should have done had it appeared under different auspices.

The history of the book may be briefly related. In July of the present year, a letter signed "a Bee Master" appeared in the *Times*, giving an account of the honey harvest at Tunbridge Wells; this was followed by others by the same writer, on different varieties of hives, and on bee subjects generally. The manifest ignorance of the author, and the numerous misstatements contained in the letters, gave rise to much adverse criticism in those journals that devote any space to apiarian matters; and Mr. Woodbury, one of the most practical, and at the same time one of the most skilled scientific bee-keepers in the kingdom, wrote a letter, which was inserted in the *Times*, opposing a few of the numerous fallacies contained in the Bee Master's communications. This called forth several letters from the Bee Master in reply. To these Mr. Woodbury, although attacked in the most personal and discourteous manner, was denied the opportunity of answering. In the course of the correspondence, the Bee Master stated that he had acceded to a request of Messrs Low to compile a book on the subject. Hence the issue of the present volume.

The work consists essentially of a reprint of the Bee Master's letters to the *Times*, including those which were written in reply to Mr. Woodbury's criticisms, which criticisms, however, are *not* inserted in the volume. The remainder of the book is chiefly made up of what is technically known as padding—80 pages out of the 224 of which the book consists are extracts from other writers. These extracts have often nothing whatever to do with the subject of practical bee-keeping, but are merely employed to swell the size and price of the volume. As evidence of this, it is only requisite to mention some of the authors and subjects cited. Thus Kirby is quoted (not from the original, but at second-hand through Lardner's twopenny tract) to the extent of eight pages, on the habits of the solitary clothier bee; Huber is laid under contribution respecting the instinct of the humble bee; Washington Irving contributes an

* *Bee-keeping by "The Times'" Bee Master.* London: Sampson Low and Co. 1864.

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account of a prairie hunt; and the description of a swarm settling on the head of Thorley's maid-servant, is quoted twice over, once at page 191, from Lardner, and again at page 196, from Thorley, the latter quotation occupying four pages. The last twenty-four pages of the treatise are made up of a number of letters obviously appended to increase the volume to the required size.

The information contained in the work is practically of a worthless character. The author is obviously wanting in that accuracy of observation necessary to constitute a correct describer; nor is his employment of language more accurate than his use of his perceptive faculties. The work, however, is written in a florid style, and, with those who read only to be amused, may answer as a substitute for a flimsy novel.

To quote the whole of the inaccuracies would be to transcribe nearly the entire volume. We will, therefore, take only a few of the more prominent. At page 135, we are informed that a swarm consists of "the outgoing queen, followed by 5000 or 6000 bees," "forming a cluster as large as the *largest bunch of grapes*." No one who had ever seen a swarm, and who possessed the slightest faculty of original observation, could possibly have fallen into such an error regarding the size of the cluster. And the statement as to the number of the bees contained in it is equally erroneous; for, in truth, about 5000 bees weigh one pound; and it is a very poor swarm that weighs only three pounds—a fair one weighing four, and a good one five pounds. This statement as to the number of bees in a swarm was made in one of the *Times'* letters, and is repeated in the volume; but at page 66 we are informed that "a strong swarm will consist of from 10,000 to 20,000 bees," and at page 99 we are told that the workers in a prosperous hive vary from "10,000 to 20,000." The author does not inform us how a prosperous hive of 20,000 workers can give out a swarm of 20,000 strong without being entirely depopulated; in fact, the three statements are alike irreconcilable and untrue; a good swarm consisting of from 20,000 to 25,000 bees, and a prosperous hive before swarming containing at the lowest estimate upward of 40,000.

The practical directions for the profitable working of hives with top boxes or supers, as they are termed, are of the most unsatisfactory character. The author recommends a hive largely used in Ayrshire, and known as the Stewarton hive. This he originally, in the *Times*, described as hexagonal, and in fact still repeatedly terms it so at page 128, where he mentions it as "the Scotch or Ayrshire *octagonal* hive, made of thoroughly seasoned deal, in the form of a

hexagon"!!! To its assumed hexagonal shape he ascribes its superiority, stating, at page 129, "it seems the bees, who construct their cells in the form of hexagons, prefer the house in which they work to be very much of the same shape." The fallacy of this argument is evident from the fact that the hive is in reality eight sided; and the want of honest truthfulness in the writer is no less evident at page 158, where he insinuates that the mistake arose from a misprint, whereas his argument is founded on the assumed hexagonal form, and therefore the statement could not possibly have been a typographical error. The mode in which he directs these hives to be used is quite opposed to their profitable employment, and could not furnish good results. This was made quite evident by a top box of honey which the Bee Master exhibited in Mr. Neighbour's window in Holborn, the comb being of a very dark colour and of inferior quality.

Of the statements made respecting the natural history and habits of the bee, we need not say more than that the *Times'* letters were some time since brought under the notice of the members of the Entomological Society by Mr. Tegetmeier, when they were received with derisive laughter; and Professor Westwood, of the University of Oxford, who is alike a profound scientific entomologist, and a skilled practical apiarian, denounced the letters as alike arrogant and worthless.

Perhaps the most objectionable part of the book is the bad feeling that it displays towards animals that do not happen to meet with the approbation of the writer. Thus he tells us, page 160, that wasps "use their stings, not like bees, in self-defence, but in sheer wickedness," a statement alike false in fact and inference. As a result of this opinion we are told that the destruction of the whole clan becomes "a *sacred* duty." Of the hornet, we are told that "of all ugly things on earth, next to the serpent, he is the ugliest, the most thievish, and the most dishonest; he is a wicked imp, a thief from his birth, feeding on corruption and full of wickedness." So ignorant is he of the natural history of the most common animals, that he tells us that wasps have "*no queen, no subordination*, that they are red republicans—Marats and Robespierres—and richly deserve the worst they get."

Of the toad he writes, he "is a lazy, ugly-looking enemy of the bee. His capabilities, however, are not equal to his will and wants. He squats under the bee-landing board, and seizes every too heavily laden or wing-weary labourer that accidentally drops. This is really very cruel. The bee that has finished the longest journey, and gone through the hardest work, and borne the heat and brunt of the hot, long

summer day, takes a rest on a leaf just before entering the hive, or comes short of the door of his home by an inch, and is seized by the unclean monster and devoured. The only way of getting rid of this unfeeling destroyer, who sits 'seeking whom he may devour,' is to pay a visit to your hives soon after sunrise and an hour before sunset; and on finding him on his wicked watch, seize him by the hind leg and throw him to as great a distance across your hedge as you well can. But if the 'bee master' be a lady, if I may use the phrase, let her empty on him a snuff-box full of strong snuff, and he will reflect a few days before he returns to his old quarters. I give this prescription to ladies because they do not like to seize the cold-blooded creature and fling him to a respectable distance," page 104.

The absurdity of the charge against this useful and persecuted animal will at once appear when it is remembered that the toad is a nocturnal feeder. Its moist and naked skin will not endure the sun's rays, and it remains shaded till the evening, when the bees are no longer abroad. But supposing the charge of the Bee Master to be true, would that be any justification of the deliberate and wanton cruelty recommended? The toad, like all Batrachians, respires in great part by its moist skin. The application of an extremely irritating poison which would adhere to the surface, and torture the creature until death relieved it from its sufferings, could not be advised by any one of ordinary benevolence, or who entertained rational ideas of man's duty towards the animal creation.

If any circumstance were wanting to prove the absence of good faith in the writer of this compilation, it would be the unblushing boldness with which he claims as his own discovery methods of proceeding described in the best-known bee books. Thus, when speaking of the wasp attacking hives, page 159, he writes, "I have hit on an admirable plan of keeping him off, well worth disclosing to every bee master. I place at the entrance of the hive a stick of barley sugar, a couple of inches long; this brings to the entrance a dozen of bees who thankfully feed on it. There is thus secured an additional guard at the gates."

This method of proceeding is well known and commonly practised, it has been repeatedly described in bee books, and may be found given at full length in Mr. Taylor's useful manual, page 111, in the edition published as long ago as 1855, and at page 117 of the current edition. As the Bee Master repeatedly mentions Taylor's work as one that he has read, and lays it under heavy contribution, there can be little doubt whence he obtained the original suggestion.

In the same manner he unblushingly declares, "I have discovered a cure (for bee stings) not found in the Pharmacopœia. Press a watch key hard on the place after receiving the sting, this prevents the poison from spreading, then apply moist snuff or tobacco." This method of preventing the poison spreading is also commonly known, and is described in the Rev. J. G. Wood's compilation at page 53. Nor can the Bee Master plead ignorance of this work, as it is recommended by him, and also laid under contribution.

We are afraid our readers will think that we have devoted too much space to the notice of a work so utterly destitute of scientific accuracy or literary skill: had it appeared under ordinary circumstances it might have safely been left to the obscurity it merits, and it is only the circumstance of its having been announced as by the *Times'* Bee Master that has given it a fictitious value, and which, unless its true character was exposed, might lead to its being regarded as a practically useful book by those ignorant of the subject of which it treats.

HABITS OF THE DIADEM SPIDER.

(*ARANEA DIADEMA*, LINNÆUS; *EPEIRA DIADEMA.*)

BY JONATHAN COUCH, F.L.S., ETC.

Several years since, in a work entitled *Illustrations of Instinct*, I attempted to trace upwards the development of animal and mental endowments, from creatures that are endowed with simple irritability, through stages of intermediate sensibility, to those higher classes which are chiefly influenced by instinct, but possess also a portion of reason which, however, is subordinate to the more powerful animal impulse; and from thence upward to man, whose instincts are indeed strong, but in whom reason so presides that the former faculty is, or may be, subordinate to the latter. But in the instances which were related, of habits and actions that had been observed in a variety of creatures, as illustrative of these principles, I forbore to bring forward any which I had noticed from the insect world, because, in the first place, they had not been sufficiently observed, and also because I felt disposed to pay some deference to the opinion then, and perhaps now held as an axiom in philosophy, that, in the

generality of insects, the usual course of life, and especially in the structures erected by them for the purpose of preserving food, as among bees, and rearing their young, they always work by a uniform plan, from which, under no circumstance, can they be made to depart. Subsequent observation, however, has led me to doubt the accuracy of these supposed truths; and in the course of the present summer these doubts have given place to certainty, especially as regards a species of spider to which my attention was first directed by its having selected the porch of entrance to my house as the sphere of its operations, and which, therefore, I continued to watch for many successive days, at the same time making notes of what was observed; and to this have since been added further remarks which have been suggested from a study of a few others of the same species of larger growth, and under other circumstances.

It has been said that, whilst a modified structure of the brain is the principal matter in the manifestation of characteristic faculties, a certain quantity of bulk also is required for affording a groundwork on which the existence of these faculties must be built; and to this principle has been ascribed the fact that, in many of the lower animals not endued with what may be termed considerable mental powers, as displayed even in the manifestation of instinct, there is still so large a bulk of brain as is little if at all inferior to that of creatures of far higher intelligence. But, if this be so, what shall we say of a creature, from which our history is derived, the whole body of which, when we first saw it, was smaller than the head of the pin with which a lady would fasten the clothes on the body of her infant baby, or a little girl will employ in dressing her little doll? Yet the considerate skill of this diminutive being in the business by which he procures his food is great, and his industry is equal to his skill, while his perseverance is not the least of these good qualities; and of all these the observations of every day afforded abundant proof.

The chosen residence of my little friend was in the outward corner of a wooden porch at the entrance of my house, and to a retired part of this it was accustomed to retire for rest, safety, and to escape unpleasant observation. But the net was spread in a more exposed part at the opening, for this spider delights in the open air; and the primary operation was to cause the thread to adhere to the cross piece or lintel above, after which it was carried below and drawn straight, so as to form the lower side of a triangle with the woodwork of the porch, and thereby limiting for the most part the extent of the subsequent operations. It is only at the extremities

of this line that the thread at first is made to adhere, and then it is that there begins a series of lines, or cords, which are made to pass from the corner or angle of the porch, to the distant thread, at regular diverging distances; and about the middle of these, or inclined a little toward one side—the nearest border of the triangle—a separate thread is brought up to the more retired recess where the little creature finds his home. It is evident that this latter is to be a cord of alarm, by the vibration of which every motion of the intended net is to be known without stirring from his place; and so well is this contrived that, even when apparently at rest, and perhaps asleep, with the head sunk and the body only appearing, with the legs extended forward, one of the hind legs retains its hold of the line by one of the joints. After forming this, the next proceeding is to draw lines from one of the diverging threads to another, beginning at the outermost, at regular closing distances, so that at last we have a net spread out in a triangular form, with cords at first running from the corner of the woodwork; which cords are crossed by short lines which pass from one to another, being of course shorter as they come near the place of retreat, and also much closer together. This, however, is only the beginning of the plan which this little artist has laid down for himself; nor is the calculation of future contingencies less evident than in some of the most elaborate works of man. One great principle is, to secure a high degree of elasticity, without which much of the labour would be in vain. A line, therefore, is carried downward from the thread which, at the lower angle of the original triangle, was glued to the wood; and it is again fastened to the same upright wood several inches below, the evident intention being that it should form a side rope for the cross lines of the web; so that while they are kept straight by it the strain may possess such an amount of elasticity as could not be provided if these cross lines were fixed on the solid wood. The next proceeding was to extend a cord from the upper woodwork obliquely down to this newly-made perpendicular line, so as to constitute a larger triangle than the first, and so on for several lines in succession, at, for the size of the workman, a considerable distance from each other; and the accuracy displayed in maintaining the proper distance was surprising, as being equal below as it was above, although this little creature had to travel over several lengths of its own body in order to fix the cord in its proper place; and yet it never failed to observe the proper measurement, although the distance was regularly diverging, and not exactly equal. At last there came a line longer than all the others, the upper end of which was attached to

the wood, and the lower end to the perpendicular line a little short of its lowest insertion; and now began another stage of the work, when the lines which formed the diverging series from the original corner of the wood were carried out regularly to the outermost border, by which a considerable degree of stability was given to the latter, and the whole extent was completed. But the meshes still continued larger than was intended; and now began the labour of filling up the vacant spaces. The commencement of this was where they were largest, which was at the border; and in doing this he passed down along each cord, and from thence out on the centrally diverging line to the required distance, at which point the cord was glued; and so on in succession for each vacancy, until the meshes were fitted in something like order, from the innermost to the outer. But in one instance, where the angle formed by the wood was much larger, a different order was pursued, and instead of the angle itself becoming the apparent centre in which the diverging lines were made to concentrate, this last point was formed not far from the middle of the web, as it was also the most distant from any solid support, as, from other instances, the most usual practise; and in accomplishing this a long single cord was carried from this at first imaginary centre, to the wood, and there the artist lay hid, watching for prey. This central line, unconnected with any other but where the smallest meshes were, had the double benefit of limiting vibration by strengthening the net, and also of conveying intelligence, whether of danger or a prize. It was observed that in the course of a day, and, perhaps, of less than half that time, the threads of the web had become covered with dust, which rendered them conspicuous, and less glutinous; but in this case the web presently disappeared, and as this was usually late in the evening, I was not soon able to discover by what agency this was effected; and indeed the chief part, if not all the work, was carried on in the twilight or after dark. But during the day I was never able to discover any flies entangled in the web, although it is probable that some very small creatures were caught; and perhaps these were moths rather than diurnal insects, since the season of activity with this spider is chiefly by night. But that food of some kind had been provided appeared from the fact that, after a week, this little creature had grown to about twice its former size. The only time in which I observed this individual at work in open day was when its web had been injured or destroyed by violence. But when the cords were only inconvenienced by dust, which in the month of June was blown about in considerable abundance, the web so soiled was suffered to continue until night, at which time, about ten o'clock, the spider proceeded to gather up its net

from all its fastenings, and to convey the mass, within its legs, to the spare side of the porch, where it was deposited, and the little workman proceeded to form another. At first, from the obscurity of the light, it could not be seen in what way this soiled net had been removed, and the supposition had even been hazarded that it had been all devoured; but when a light was directed towards him to ascertain the truth, with the aid of a large magnifier, the little fellow ran off to his hiding-place. His method of disposing of these materials was afterwards discovered, but not without the exercise of much patience and attention. But before the whole of the soiled materials had been removed, some new cords were laid for the formation of another web; the arrangement not being exactly on the model of the former, for the lines especially were longer, and it was remarked that when the diverging cords were laid out very long, they were strengthened at their extremities with additional moorings at the sides.

The quantity of material employed in forming a new net appears to be nearly as much as would constitute the bulk of his body, and yet he has continued to renew it in twenty-four hours for three or four days; but at last, after two interruptions, it was noticed that at ten o'clock at night he had not resumed his work; and on the following morning, although the new web was complete, its dimensions were less, and the central narrow meshes were more towards the side. The arrangement therefore was altered; but from the slackness of the work, and the less activity in forming it, it was judged that the materials within the body had become exhausted; and thus this little industrious being was compelled to rest until nature should provide for it a new supply. But another misfortune, and to both of us, soon followed, in the work of one to whom the existence of a spider's web appeared a reproach; and on a day of cleaning, in my absence, the whole was swept away, although I have the gratification to believe my little acquaintance suffered no further than in experiencing a change of residence.

It was my fortune, however, to find that another of the same species and size was at work in broad daylight, and that too with a variation in the manner of proceeding which displayed a different turn of mind from the former, and in a new degree a power to overcome difficulties. When first discovered there existed a small portion of an old soiled web, and he began with one that was carried to a larger extent, but he did not disdain to join the new and beautiful fabric to this border piece of perhaps some former workman; a scheme that I have seen put forth in other instances by spiders of the largest growth. On this occasion a brisk wind was blowing, and the artist found it difficult to hold on to his thread from its shaking in the wind. The piece of old web in particular shook much.

To render the work firmer, therefore, he passed up and down the longest and most exposed of his own lines five times, and at each journey he joined to the former a new cord, which, from its glutinous nature, closely united with it, and rendered it thicker, and of course stronger. This accomplished, his next proceeding was to travel up one of his very fine adjoining lines, and to gather up to himself a portion of the old soiled cord and cast it free. Returning thence to the remainder of the old, he gathers up a much larger portion and casts it to the winds. It is too dry to adhere to the new thread, a portion of which it touches as the wind acts on it; and in then going on them to form the diverging threads, this individual carries each one fully out to the outer long and strengthened line, which we may term the cable; and then he begins the cross cords, with the outward portion first—which seems the rule with all these little schemers; and what is intended to be the centre, is marked by the diverging threads on all sides coming to a point: which ever has a reference to the place of concealment and rest. It may have been in consequence of the troublesome wind at that time prevailing, that several of the encircling threads which form the meshes were placed in an angular direction in regard to others, and not in regularly recurring parallel lines. When a strong and harsh east wind was blowing, although the web was soiled and torn, it was left to itself, and the adult spider remained in its retreat, with its head low, and the first legs stretched forward; but although appearing to be insensible or asleep, his left hind leg held fast by the warning thread that still continued stretched out. An east wind appears to be hateful to these little creatures, and a bright light distasteful; but what they commonly feed on is not easily ascertained. I will only add further, that in gardens the outer threads of the web are sometimes carried to such distances as to show that they must have been shot forth, and carried on the air; after which the progress of the structure must have called forth even a higher degree of skill and patience than what is mentioned above.

> "*How* can these spiders parallels design,
> Sure as De Moivre, without rule or line?"

If all this was the routine of instinct, what is it that presides over embroidery, or taught a man to build St. Paul's?

I will add, also, that in instances when the web was spread where it could not be fastened except at its sides, the cord of warning was omitted, as evidently it could not have been of use; and further, that when the dry east wind blew for more than a week, the net, although useless, was not removed or renewed; but on an alteration to milder and moist weather it disappeared, and a new one was formed.

PHOTOGRAPHY.—PROCESSES AND PRECAUTIONS.*

BY J. W. M'GAULEY.

THE principle of the Daguerreotype is essentially different from that of every other photographic process. It consists in the production of an exceedingly delicate compound of iodine or bromine and silver, on a silver surface; this compound is changed by the action of light, but the change is imperceptible until the picture is brought out by vapour of mercury. The light appears to decompose the iodide or bromo-iodide of silver, and the liberated iodine and bromine act on the plate underneath the sensitive film; the mercury, by forming an amalgam with the reduced silver, produces the lights. If the newly-formed iodide and bromide were not removed by the fixing agent, they would attack the mercury. Paper covered in various ways with an argentine surface, has been proposed as a substitute for plated copper, but without complete success. There is reason to suppose that the copper of the Daguerreotype plate not only supports the silver but contributes to the effect.

Removal of the undecomposed Silver Salts. The undecomposed iodide, etc., of silver may be removed by a solution of common salt, especially if the plate is touched with a zinc rod; but it is far better to use hyposulphite of soda. The use of this salt for the ordinary purposes of photography is, however, attended with several inconveniences; among others, it sulphurs positive proofs. Cyanide of potassium may be used instead of it, but is a very dangerous substance. Sulphocyanide of ammonia is very effective as a fixing agent, both with glass and paper, with positives and negatives: though so energetic, it does no injury to the middle shades; but unless, before using it, the picture is immersed in a strong gold toning bath, it will be likely to have a reddish hue. Unlike cyanide of potassium it is a harmless compound. The great resemblance between the salts of selenium and those of sulphur suggested the substitution of selenio for sulpho-cyanide, and it was found to dissolve the undecomposed silver salts; but feeble acids, which have no action on sulpho-cyanide, decomposes selenio-cyanide.

Sensitization of Paper. To imbue paper with chloride of silver, it is first washed with some substance which contains chlorine; this is changed into chloride of silver by the addition of the nitrate. Common salt may be used for the purpose;

* This is the fourth and concluding paper—the first, on "The History of Photography," is in No. 27; the second, on "Photographic Processes," in No. 28; and the third, in No. 33.

but salted paper, though well suited for the artist who may wish to retouch the picture, is, on account of the way in which paper is manufactured, liable to several imperfections.

The nature of the material used, the mode of sizing, etc., modify the photographic results. The metallic stains, produced by abrasion of the instruments used in preparing the pulp, are brought out; maize paper, being made without the machinery required for tearing the rags in pieces, is free from particles of metal. A picture produced on paper, by means of nitrate and chloride of silver, may be effaced by washing with a solution of corrosive sublimate, so that, unless iodide is present, no trace of it will remain; it will, however, be revived by hyposulphite of soda, or caustic ammonia.

Albumen, Collodion, etc. When the silver salt is diffused through the whole substance of the paper, the solidity of the picture is augmented, on account of its penetrating to a greater depth, but there is a serious waste of a costly material. To prevent this, the paper is coated with albumen, glue, isinglass, etc., and only the film produced by these substances is sensitized. Albumen is spread with difficulty, and is very liable to dust. It is a mistake to suppose that it can be coagulated by the same means as white of egg in its normal state. White of egg is coagulated by a temperature not exceeding about 146° Fahr.; dry albumen is scarcely coagulated at all by mere heat, and is not altered by a temperature of nearly 400° Fahr. Since, however, its coagulation is very desirable, for the purpose of economizing the nitrate of silver, many attempts have been made to render it easy; metallic salts have been found very effective for the purpose. When albumen is used, the picture contains three superimposed images, one formed by the albuminate of silver, another by the chloride, and a third by the nitrate; the two first, when in good proportion, secure a proper balance between the lights and shades; if there is too much albumate, the picture will be red, purple, brown, and finally metallic, with a red shade, which the toning bath will with difficulty, if at all, correct. The nitrate augments the intensity, and secures rapidity.

Waxed paper affords positives which are free from the imperfections due to the transmission of light through negatives of irregular texture and more or less yellow in colour, but it is not always uniformly translucent; and as it is with difficulty permeated by liquids, it contains but a very small quantity of the silver salt. To obviate the latter inconvenience, paper rendered transparent, by means of gelatine, certain resins dissolved in alcohol, etc., are sometimes employed, but a plate of glass has much the advantage of all other media; and the collodion with which it is coated may be considered as a species of paper

totally free from the imperfections of the ordinary kind; it has no inequality of pores; it is quite homogeneous, being, what no other paper is, pure cellulose; and it greatly exceeds albumen in sensitiveness. It loses this sensitiveness, however, with great rapidity by becoming dry; but this imperfection is not quite irremediable, since, if a certain quantity of albumen is mixed with it, rapidity is in a great degree preserved, and the plates may be kept for some days without being used. Collodion is the more effective, since the silver salt is diffused through its whole substance. The reddish tint of old collodion is due to iodine which is set at liberty; this causes it to have less rapidity, and a greater tendency to solarization than new, but it gives a more intense image. The addition of carbonate of soda in solution not only restores the collodion thus reddened, but augments sensibility, and increases the density of the image.

The time required for exposure with the so-called dry collodion is diminished by washing the plate after it is taken from the sensitizing bath, then dipping it in tannin, and again washing it. The tannin keeps the pores of the sensitive coating open, and also exerts a stimulating action on the iodide of silver, so as to render the effect of the light more intense and more complete; but its chief advantage is during the development. A merely bromurated collodion, with tannin, is quicker than one with iodine and bromine without it. The contrary is the case with moist collodion. The latter owes its sensibilty to the nitrate of silver, which, in drying, not only crystallizes, but forms a double salt with the iodide. Hence, to obtain a quick dry collodion, we must employ a bromo-iodide, and remove the nitrate by washing. If glycerine is mixed with the nitrate used in sensitizing collodion, as it does not dry, it will keep the surface moist, so that the plate may be left for at least a day without being used. If the glycerine is applied after exposure, the developing and finishing may be postponed.

Development. In developing negatives, the bromide and iodide are reduced in those places where the light has acted, by protoxide of iron and gallic acid; the latter seizes the oxygen of the oxide, and its affinity for this element is so strong that it will precipitate metals, in a pure state, from even powerful acids. The substitution of formic for acetic acid, in a developing fluid, seems to give greater intensity to the picture, and, by consequence, shortens the time required for exposure. It has been found that when formic acid is used, a picture may, in favourable circumstances, be taken in less than a second. A negative is changed into a positive picture, by rendering the reduced silver white and brilliant, instead of allowing it to retain the appearance it presents in a negative. For the purpose of judging whether or not a negative will give a good positive, it may

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be made a positive by reflection, without ceasing to be a negative by transmission. This is effected by covering it, after having been washed once or more times, with chloride of gold, which blackens the details, and renders them visible by reflected light; as occurs in toning, the gold is precipitated by the metallic silver; and if, instead of the latter, copper or zinc were present, the precipitation would be still more rapid. A solution of bichloride of mercury might be used instead of the gold, but its effect would not be so certain.

ACCIDENTS AND FAILURES TO WHICH PHOTOGRAPHIC PROCESSES ARE LIABLE.

Silver Bath. Notwithstanding very great care in preparing materials, and performing the various manipulations, accidents occasionally occur, and defects are perceived, for which it is sometimes difficult to account. Most of these, however, are due to the state of the nitrate of silver bath. If, with albumenized paper, it is too weak, in proportion to the amount of albumen, or too acid, the picture will have a disagreeable reddish tone. In the former case, the addition of a small quantity of nitrate is the remedy; in the latter, powdered chalk and filtration. A weak silver bath may be the cause of many imperfections in the picture; but the addition of nitrate of soda will cause it to give more brilliant positive proofs than a strong bath containing only the silver salt. After a bath has been used for some time with albumenized paper it is darkened and rendered impure by the albumen it has dissolved. Evaporating to dryness will cause the organic matter to be destroyed by nitric acid; adding a little nitric acid will change the reduced silver into nitrate; evaporating again to dryness, and slightly fusing, will afford perfectly pure nitrate of silver ready for solution. No silver is lost during the process.

The sensitizing bath used with collodion requires special precautions. The collodion and the bath must be both acid, or both neutral, otherwise there will be a want of sensibility. The most effectual means of giving the greatest possible degree of sensibility to a collodionized plate intended for a negative, would be the use of a silver bath saturated with iodide of silver, and absolutely neutral. But since, with such a bath, the picture will often appear clouded, and especially in the places not acted on by light, it is usual to give the bath a slight degree of acidity; this, however, will be unnecessary if a small quantity of iodine is added to it. In about fifteen or twenty days after, the bath will indeed become slightly acid; but it may again be rendered neutral with carbonate of silver. If, before adding the iodine, the bath was not saturated with iodide of silver, some of the latter will be formed; in which case, nitric acid being set free, great acidity will result. If the bath is feeble, com-

pared with the degree to which the collodion has been iodized, tracks will be left in the path followed by the fluid during the act of immersion, and the sensitization will be unequal. When a silver bath becomes weak by use, the iodo-nitrate of silver crystallizes, and the crystals settle on the collodion, adhering strongly to it, and causing it, after fixing, to be full of small holes. Since this excess of iodo-nitrate cannot be removed by filtration, it must be decomposed into iodide and nitrate by greatly weakening the bath with water. The iodide then precipitates and is retained by a filter; and the strength of the bath is restored by adding nitrate of silver in proportion to the quantity of water used in weakening. The bath may, however, be kept from this inconvenient state by adding, daily, as much nitrate as is removed by the plates.

If an old, or partially dried filter is used with the silver bath, the molecules of silver deposited on it, on account of the decomposition caused by the organic matter, will take oxygen from some of the nitric acid. The bath will then be slightly yellow, and will contain a soluble nitrate and an insoluble basic nitrate; and only grey, clouded, and indistinct pictures will be produced. A few drops of an alcoholic solution of iodine will remove the excess of silver which is in the subsalt, and bring the bath to a proper condition. If, when the plate is lifted from the bath, the collodion presents a greasy appearance, there is too much alcohol in the bath; it is derived from the collodion, the ether of which passes off more readily by evaporation. The alcohol is got rid of, by keeping the fluid for a few moments at nearly the boiling point. Greasiness would lead to want of uniformity in development.

If after a collodionized plate, which is to be used in the humid way, has been taken from the silver bath, it is carefully washed, before exposure, all kinds of stains and imperfections will be prevented, whatever the state of the bath; but, in developing, a quantity of nitrate of silver, sufficient to replace what has been removed by the washing, must be added. The sensibility is somewhat diminished, and the development is more tedious, but the plate may be left for many hours in the water previous to use, which, in some cases, is an advantage—as, for instance, in taking a photograph of the moon, when it may be necessary to wait until clouds have passed.

The use of gutta-percha for the silver bath is found to produce cloudiness and streaks in the collodion proofs, on account of the large quantity of tannin which it contains. It is supposed also that the gutta-percha itself, though it resists strong acids, is attacked by some of the materials used. The presence in the negative bath of a very small amount of a reducing agent produces serious effects on the film. A gutta-

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percha bath continues to decompose the nitrate, until it is saturated with the salt; and some kinds of gutta-percha never become fit for use. Gutta-percha may have an injurious effect, without either causing a deposit, or producing turbidity.

If collodion contains too little water, not only is its sensitiveness diminished, but several imperfections are produced in the picture. As to perfectly anhydrous collodion, it is difficult to obtain, and still more difficult to preserve unchanged; since, while being used, it attracts moisture from the atmosphere. If the collodion cracks and separates from the plate, the evil is prevented by the addition of honey; which also renders collodion that has lost its sensibility by age fit for use. Great solidity is imparted to collodion by adding ether, by itself, or along with a small quantity of alcoholic solution of iron, and by albumen mixed with water charged with dextrine.

After a negative has been exposed for, apparently, a sufficient length of time, it may be found that the sensitive coating has not been acted upon by the light to such a depth as that the reduced silver will be large enough in quantity to intercept the light so as to afford a good positive; and if the ordinary means of intensifying are employed, the collodion may be softened, or the details may be obliterated. These inconveniences can all be prevented, by causing light to continue the work which was begun in the camera. For this purpose, when the picture has been brought out, whether by gallic acid or by protosulphite of iron, it is to be washed, and then subjected to the action of light, which causes the picture to go on acquiring vigour in a surprising manner. The light affects only those parts on which it acted when the plate was in the camera; since the reducing agent has taken away all the silver, except that forming the picture. Such an effect cannot be produced after fixing, because the hyposulphite removes all the iodide of silver which has not been sufficiently acted upon.

Gradual deterioration of Photographs. As yet, we cannot be certain, whatever care we take, that a photograph will not deteriorate by time; for it has been ascertained that the very substances which are used to prevent light from further action, may sometimes, themselves, attack the shadows and half-shadows. Moisture is one of the chief causes of the deterioration of paper photographs. It is avoided by using paper which has been dipped in a liquid that consists of alcohol, benjamin, and chloride of cadmium, and drying; then sensitizing in the way usually adopted with albumenized paper. Prepared in this manner, paper has its sensibility increased. Benjamin, either by itself, or mixed with another resin, may be substituted for albumen, etc., in the preparation of paper for

positives; it imparts brilliancy to the paper, augments its sensitiveness, and causes moisture to have no effect upon it; it affords good proofs from even feeble negatives, and the slight tinge of cream colour causes it to impart vigour.

Another cause of deterioration consists in the presence of hyposulphites; these are to be removed only by the most careful washing, with abundance of water, which is frequently changed. The washings may be from time to time tested, by adding to a small quantity of them some hydrochloric acid and metallic zinc; if an hyposulphite is present, the nascent hydrogen will form sulphuretted hydrogen: and this will be detected by paper that has been steeped in a solution of acetate of lead, and, while moist, exposed to the vapour given off by sesquicarbonate of ammonia. The test paper, before being used, should be held in the vapour of boiling water. If no discoloration is produced on the lead, no danger to the picture need be apprehended from the presence of a hyposulphite.

Albuminate of silver, which is acted on by light, is in some instances the cause of deterioration; it is not removed with hyposulphite, whatever care may be taken. The nature of the combination formed by albumen and silver depends on the strength of the silver bath; the stronger the latter, the more insoluble the albuminate; a weak bath would, however, dissolve off albumen, and render the picture less effective. The albuminate may be removed by sulpho-cyanide of ammonia; but when this is used as a fixing agent, stronger copying and toning are required.

We have treated this interesting subject at considerable length, but we are far from having exhausted it. Desiring to keep within as narrow bounds as possible, we have avoided minor details, confining ourselves to those which might be considered interesting, from their importance, their novelty, or the suggestions to which they gave rise. We have endeavoured to present to those who are not photographers, a general view of the subject; and to those who are, an abstract of its fundamental principles, with a view to the more accurate performance of the processes which depend upon them: as well as a brief account of the discoveries which have been made within a very recent period.

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COMETS.

AN ACCOUNT OF ALL THE COMETS WHOSE ORBITS HAVE NOT BEEN CALCULATED.

BY G. F. CHAMBERS.

(*Continued from Page* 137, *Vol.* vi.)

1155. A comet was seen on May 5.—(*Chronicon Monasterii Admontensis.*)

1162. On November 13, a great comet appeared in the square of Pegasus. It went towards χ and ψ Aquarii. Its tail was more than 10° long.—(Gaubil.)

1165. [i. and ii.] Two comets appeared this year, in August before sunrise. The one in the N. the other in the S.—(*Chronica de Mailros.*)

1181. In July a comet was seen.—(*Chron. Mailr.*) It appeared shortly before the death of Pope Alexander III. which happened on August 30.—(Cavitellius *Annales Cremonenses.*) Gaubil mentions a new star seen on August 11, under the footstool of Cassiopeia. It disappeared after 156 days. Nothing is said as to its having had any movement.

1198. In November a comet appeared for fifteen days. It announced the death of King Richard I.—(Coggeshall, *Chronicon Anglicanum.*) Richard died on April 6, 1199.

1204. In the year of the capture of Constantinople by the Latins, a great comet appeared.—(Sicardus, *Chronicon.*)

1208. A comet appeared.—(*Chronicon Weichenstephenensi.*) A brilliant star, like a fire, appeared after sunset for two weeks. The Jews regarded it as a sign of the approach of the Messiah.—(Cæsar Heisterbacensis, *Excerpta Hist. Memorab.*)

1211. In May a comet was seen for eighteen days in Poland.—(Cromer, *Polonia*, vii.)

1214. In March two terrible comets were seen.—(Bœthius, *Scot. Hist.* xiii.) No doubt a single comet with a considerable N. declination, which will accord with the statement of one comet preceding, and the other following the sun.

1217. "In the autumn, after sunset, we saw a beautiful sign; a star which soon sank below the horizon. This star was towards the S., pointing a little W. Its position faced the crown of Ariadne."—(*Chronicon* Conradi Abbatis Urspergensis.) Pingré understands the above expression to mean that the comet's azimuth was as much W. of S. as that of Corona Borealis was W. of N.—(*Comét* i. 398.)

1222. In the months of August and September, a fine star of the first magnitude, with a large tail, was seen near the place where the sun sets in December.—(*Annal. Wavel., etc.*)

It was observed in China, on September 10, between the feet of Virgo, Arcturus, and Coma Berenicis. It disappeared on October 8.—(Gaubil.) On September 25 it came from η Boötis. The tail was 30° long. The comet traversed the third, fourth, and fifth sidereal divisions, and then disappeared, after remaining in sight for two months.—(Ma-tuoan-lin.)

1223. Early in July a comet appeared for eight days in the western heavens, and in the evening twilight. It was looked upon as the precursor of the death of Philip Augustus King of France.—(*Chronique de France.*) Most probably *Halley's Comet.*—(Hind.)

1230. A comet appeared.—(Dubravius, *Historiæ Bojemicæ*, xv.) On December 15, an extraordinary star appeared between Ophiuchus and Serpens, below the stars F. and D. in the head of Cerberus. On March 30, 1231, it had disappeared.—(Ma-tuoan-lin.)

1232. On October 17, a comet 10° long was seen in the E., to the S. of α Virginis. On the sixteenth day of its apparition it was close to the moon. On the twenty-seventh day, at the fifth watch, it *reappeared* in the S.E. and was 40° long, and was finally lost sight of on November 14.—(De Mailla, ix. 173.) Gaubil says it began to disappear on December 2. —(Biot.)

1239. A comet was seen in February.—(*Synop. Chronol.*) Shortly after the birth of Edward, son of Henry III., at the commencement of 1238, a splendid comet appeared for several days before sunrise.—(Polydore Virgil, *Anglica Historia*, xvi.) Edward was certainly born in 1239, so no doubt the Chinese date in the correct one.

1240. On January 25, a comet was seen at the end of that month, it was observed in the W. During the month of February it continued to appear in the same quarter of the heavens, the tail pointing to the E.—(Rolandinus, *Chronicon* v. 1.) In China the comet was seen near α and β Pegasi; on February 23 it passed to the S.E. of α and β Cassiopeiæ. It lasted eight weeks.—(Biot.)

1250. A comet appeared in December, about the time of the death of the Emperor Frederick II.—(*Gesta Trevirensium Archiepiscoporum*, No. 266.)

1254. In November a comet appeared.—(Petrus Pictariensis, *Chronicon.*)

1262. A comet appeared for several months.—(Crucius, *Annales Suevici*, pt. iii. lib. ii.)

1263. In July and August a comet was seen in the E.—(Gassarus, *Annales Augustburgenses.*) Of doubtful authenticity.

1265. A comet appeared at the beginning of autumn, and

lasted till the end of that season. It was visible from midnight.—(*Chronicon Mellicense.*) It was first seen in September.—(Franciscus Papinus, *Chronicon.*)

1266. In August, before daybreak, a comet was seen near the sign Taurus.—(Gregoras, *Historia Byzantina.*) A total visibility of three months may be inferred.

1269. In the twentieth year of the reign of Alexander, King of Scotland, a very fine comet appeared towards noon [sub meridiem].—(Bœthius, *Scotorum Historia,* xiii.) Probably *towards the south* would be a better rendering.—(Pingré, i. 415.) It was observed in the E. in August and September.—Malvecius, *Chronicon Brixiense.*)

ARCHÆOLOGIA.

BARROW DIGGING IN YORKSHIRE AND SCOTLAND—DISCOVERIES IN THE ANGLO-SAXON CEMETERY AT SARR.

The summer and autumn of the present year have witnessed some rather interesting antiquarian operations in the shape of barrow digging. Perhaps the most important of them was the exploration of some of the ancient tumuli on the estate of Castle Howard, the seat of the Earl of Carlisle, in the North Riding of Yorkshire, which was described rather fully in the *Times* of the 13th of September. The first barrow opened was situated at the base of the Slingsby Banks, was sixty feet in diameter, and about eight feet high, and had been broken into at some rather remote period by treasure seekers, who had very much disturbed its contents. These consisted of a considerable quantity of ashes, mixed with lumps of charcoal, fragments of several urns, a few wrought flints, and human bones, charred. Indeed, the action of fire was observable on all the objects found, which appeared to have constituted at least six interments. For the first deposit, the ground appeared to have been hollowed out like a bowl, and the mound had been raised over it. A smaller tumulus in the same neighbourhood, about sixteen feet in diameter, and not quite two feet high, was next opened, and was found to contain only burnt bone and ashes, which had similarly been deposited in a hollow. Another large tumulus, about thirty yards in diameter, and eight feet in height, was subsequently opened, and was found to contain only one interment. An urn, "magnificently scalloped or pectinated," and further described as being "not of the usual form of the cinerary vessel, but with three external rims, ornamented very irregularly in four horizontal rows of sharp, angular indentations," had been placed in the centre on a floor of concrete.

On the whole, the discoveries made in these barrows are not apparently of very great importance, with the exception, perhaps, of the pottery, which requires a more careful examination. We have not repeated such terms as "Brigantian," "British," etc., applied to these objects in the account printed in the *Times*, which are, perhaps, better avoided, because they imply the decision of questions which are at present not at all decided. As far as we can judge by the description of the contents of these barrows nothing has been found but the pottery which can give any assistance in determining their date, and that, therefore, requires a more careful examination. There are reasons for suspecting that many, at least, of these barrows which are scattered over the downs of the North and East Ridings of Yorkshire, instead of being Brigantian or British antecedent to the Roman period, may belong to that later period which intervened between the age of Roman imperial domination and the settlement of the Angles in the Northumbrian kingdom, and as this question is an interesting one, it is desirable that the objects found in the barrows should be as carefully preserved and examined as possible.

On the 16th of August a large tumulus on Norries Law, near Largo, on the coast of Fife, Scotland, was opened and examined. It appears to have had two circles of stone, surrounding a cairn, the stones of which bore marks of burning. On one side was found a small triangular cist, containing human bones, which had been burnt, and near it was an urn, among wood cinders. The urn is not described. The most remarkable circumstance connected with this tumulus is that, about half a century ago, some objects formed of silver were found near it, though it does not appear that they had any direct connection with it. These objects, which are interesting on account of the curious figures engraved on them, are now deposited in the Museum of Antiquities at Edinburgh, where they can be easily examined.

We turn from these to another class of barrows, which are at least much more productive of interesting results, and at the same time with comparatively much less labour. All who were present at the meeting of the Kent Archæological Society at Sandwich, last August, must have been struck with the beautiful display of Anglo-Saxon jewellery, personal ornaments, and other articles, in the temporary museum. These objects were obtained from barrows in East Kent, and especially at Sarr, in the Isle of Thanet, where, in the autumn of last year, an extensive Saxon cemetery was partly excavated at the expense of the Kent Society. The excavations were carried on under the careful direction of Mr. John Brent, jun., the well-known antiquary of Canterbury, and, among the objects found in them, besides the usual weapons and implements in iron, such as swords, umbos of shields, spear-heads, knives, and keys, there were found several glass vessels, much pottery, a pair of scales of bronze with the weights, a door-lock, with bolt, constructed to work diagonally, a horse's bit, an axe-head, two weapons like a Highland dirk and knife, in one double scabbard, a pike three feet nine inches long, a spear with a fastening like that of a modern bayonet, a sword with two plates of silver, forming part of the guard, an

enamelled sword-pommel, a beautiful clasp of a belt, with a plate of gold in the centre; shears, bronze tweezers, bronze and bone hair-pins, children's toys, a number of draughts or counters, probably for playing some game, beads of great variety, formed of amber, amethyst, glass, porcelain, and coloured clay; carbuncle pendents, set in gold and silver; a great variety of fibulæ, etc. All these objects are preserved in the Kent Society's Museum at Maidstone.

We are glad to be able to announce that these excavations have been resumed, still under the directions of Mr. Brent, and with the same success as before. The museum at Maidstone, which is open to the public, is well worth a visit. A full account of last year's diggings is printed in the newly published volume (the fifth) of the *Archæologia Cantiana*, or, Transactions of the Kent Archæological Society. T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

MEETING OF THE BRITISH ASSOCIATION AT BATH.

(*Continued from our last.*)

On Monday, Sept. 19, Dr. LIVINGSTONE gave a lecture descriptive of the proceedings of his last African exploration. He stated that, previous to the Zambesi expedition, and the discovery of Lake Ngami and the Makololo country, it was imagined that the interior of Africa was composed of vast, sandy deserts, into which rivers ran and were lost. But journeying across from the Indian Ocean to the Atlantic, it was observed that the country was well watered, that large tracts of fertile soil were covered with forests, and supported a considerable population; the interior of the continent being an elevated plateau, somewhat depressed in the centre, with fissures at the sides, by which the rivers escaped into the sea. On the west coast Dr. Livingstone found that slavery had been abolished, the slave trade suppressed, and that commerce had increased from £20,000, in ivory and gold dust, to between £2,000,000 and £3,000,000 of exports, of which £1,000,000 was palm oil; that twenty missions had been established, and schools founded in which 12,000 pupils were taught. On descending the Zambesi to the east coast, there was found neither trade nor commerce, as foreigners were debarred from entering into the country. To open up this country was the main object of the Zambesi expedition. The first discovery made was a navigable entrance to the river, about a degree west from the Quillimane River, which has hitherto been falsely represented as a navigable mouth to the Zambesi. Dr.

Livingstone complained strongly of the inefficiency of the steamer with which he was provided, which was passed by the native canoes. Proceeding inwards they explored an affluent of the Zambesi called the Shirè, this winds amongst marshes in a valley 200 miles in length, in one of these they counted at one time 200 elephants; in other parts the population was very large, the men being armed with bows and poisoned arrows. On a second visit they discovered the Manganja, a people not hitherto visited by any Europeans. These savages were described by Dr. Livingstone as being very low in the scale of humanity; nevertheless, they cultivate the soil, raising large quantities of maize and dhurra, cassava for tapioca, ground-nuts for oil, and Indian hemp for smoking, the whole family labouring on their patch of ground, the men skeining the cotton, the women malting the corn for the purpose of making an intoxicating beverage, on which they occasionally all get tipsy together. They also possess the capability of extracting iron from its ore, and make excellent hoes very cheaply. Proceeding northward, they discovered the Shirè flowing a broad stream to Lake Nyassa, between ranges of elevated plateaux, cool, and well watered with streams. Dr. Livingstone used his utmost endeavours to induce the various tribes to cultivate cotton for export, as the cotton is of excellent quality, and the plants do not require renewal oftener than once in three years, the locality being asserted by the Doctor to be one of the finest cotton fields in the world.

Dr. Livingstone's views respecting the method of converting the natives, are of the most sensible and practical character; he maintains that their bodily wants must be attended to as the basis of all efforts at their elevation.

Carrying a boat past Murchison's Cataracts, they sailed into Lake Nyassa, a fresh-water lake of great depth, abounding in fish, which the natives catch with nets, hooks, poison, and by spearing by torchlight. Crocodiles also abound, but from the abundance of fish rarely attack men. The lake is between fifty and sixty miles broad, and its length is certainly over 225 miles. Before Dr. Livingstone left for England, the African Portuguese slave-traders had induced the Ajawa tribe, whom they furnished with fire-arms, to be paid for in slaves, to attack the Manganja nation, who are armed only with bows and arrows; the result was that a panic seized the latter, who fled, leaving all their food behind them, and the starvation of thousands ensued, the fertile valley of the Shirè becoming literally a valley of dry bones, unburied skeletons lying in every hut of the deserted villages. From the depopulation of the country, Dr. Livingstone was unable to get his steam vessel, which was made in twenty-four detached pieces, for convenience of carriage, conveyed past the Murchison Falls, and hence the failure of the expedition. But his next attempt will be to pass into the country north of the Portuguese.

Dr. MILLER made some remarks on THE SPECTRA OF THE HEAVENLY BODIES, examined by Mr. Huggins, in which he stated that the presence of metals, as evidenced in the light of the planets and some of the heavenly bodies, proved them to be similar to ter-

restrial substances, while the nebulæ were evidently bodies of gaseous vapour, the character of their light showing that there was no solid body behind.

Mr. F. C. Calvert communicated A New Method of Extracting Gold from Auriferous Quartz, so as to obviate the necessity of employing mercury, which is both expensive and very deleterious. Finding that gold, though but slowly acted on by a solution of chlorine, is readily dissolved by that agent as it is liberated from its other combinations, or as in a nascent state, Mr. Calvert suggests that the auriferous quartz should be acted on by hydrochlorine and peroxide of manganese, when the gold is readily and completely dissolved, and is, after the separation of any copper that may be present, afterwards precipitated in a metallic form by a solution of protosulphate of iron (the green copperas of commerce).

Mr. Spencer read a paper on Economising the Sulphur Evolved in Copper Melting. He described a furnace in which the sulphurous fumes evolved during the calcining of the ores were conveyed into the chambers employed for the manufacture of sulphuric acid; he estimated the loss of sulphur from the present wasteful and deleterious modes of calcining the ores as amounting to 70,000 tons per annum, the money value of which would be upwards of £400,000.

Dr. Machaltee furnished a paper on the Detection of Poisons by Dialysis — a probable application of this valuable discovery, which was pointed out in the article on Dialysis in the 1st volume of the Intellectual Observer, page 384,—in which he suggested that the stomach or intestines of an animal suspected of having been poisoned by any substance capable of being dialysed, might be made to act as their own dialysers, by simply tying the openings so as to securely enclose their contents, and then plunging them into a vessel of water for some hours, when the crystalline poison, such as arsenic or strychnine, would dialyse out, and could be readily detected in the external fluid.

Dr. Daubeny made some interesting remarks on the Decay of Species, and on the Means of Extending their Duration. It was assumed as a fact, that species (like individuals), both in the animal and vegetable kingdom, wear out after a certain period; but it was suggested that there are natural contrivances whereby this inevitable termination was postponed to a later period than would otherwise happen. The author suggested that one of these provisions was the formation of new varieties, which diverged from the original type, acquired great vigour, and so prolonged the existence of the species from which they were derived; consequently, plants propagated by cuttings, which adhere to the same type as that one from which they were immediately obtained, seemed to be more limited in their duration than those produced from seeds. The production by seed of plants which vary somewhat from the original type, is more completely carried out when the pollen of one individual is made to fertilize the embryo of another; hence may arise the necessity for these numerous and singular contrivances for preventing self-fertilization which have been pointed out by Mr. E. Darwin and others. The author mentioned, however, that eventually, even

with every faculty for producing the utmost amount of variation of which a species is susceptible, a period at length arrives when the species dies out, although the climate, soil, and other external conditions, continue as far as we can conceive propitious.

Dr. T. Spencer Cobbold read a paper on Meat as a Source of Tape-worms in Man, in which he alluded to the difficulty of detecting these parasites in their early condition in the flesh of the animals used as food, and stated that all danger arising from them might be obviated by the employment of meat in a properly cooked condition. He assigned a considerable proportion of the deaths usually attributed to epilepsy, to the development in the human brain of a living embryo taken into the system in half-cooked pork.

The General Committee of the Association decided that the next meeting should be held at Birmingham, under the Presidentship of Professor Phillips.

NOTES AND MEMORANDA.

The Eighty-first Planet.—We learn from the *Astronomische Nachrichten* that M. Tempel of Marseilles discovered what appeared to be a new planet on the 30th September. He referred the matter to Dr. R. Luther, who confirmed his belief, and estimated it at from 10 to 11 magnitude. Dr. Peters has assigned to the new body the name of Terpsichore. Mean position 1864, 0 = 5ʰ 4′ 8″·8 + 2° 47′ 38″·3.

Duration of Twilight.—Herr Julius Schmidt, of the Athens Observatory, communicates to *Astronomische Nachrichten* a series of observations to determine the duration of twilight, and the height of the atmosphere. He arrives at the conclusion that the minimum height of the atmosphere ranges from 7·5 to 10·5 geographical miles (15 to an equatorial degree?), and that it varies with the time of year, being highest in November, December, January, and lowest in May, June, July. The depression of the sun necessary for the close of twilight is not constant, the ordinary reckoning of —18° being correct only in extreme cases.

Treatment of the Insane.—The Conseil Général of Vosges believing that it is disadvantageous for insane patients of the idiotic type (fous) to be constantly associated with other mad people, has determined to make an allowance to enable their parents to keep them at home, or at farm houses, where they will have the benefit of sane companionship and fresh air. This system appears restricted to cases in which the patients can be safely left at liberty, and so far as it has been tried it has succeeded.

New Sources of Silk.—M. Guérin Méneville describes to the French Academy cocoons which he has received from Uruguay. They are produced in abundance by a silkworm found on a species of mimosa. The trees are covered with the silk to the height of more than six feet from the ground. The caterpillars are orange with black spots, and the fresh cocoons are orange, but lose their colour by exposure to the sun and rain. The cocoons are deposited on the sunny side of the bark; they are oval, slightly pointed, and open at the side. The silk is of fine quality. M. Méneville calls the moth *Bombyx Fauvetii*, in honour of the discoverer. In the same communication, he writes that a *Bombyx Atlas* has emerged from a cocoon at the Imperial farm at Versailles. This moth is the largest of the Lepidoptera, and its cocoon is four and a-half times as heavy as that of the ordinary silkworm. M. Méneville hopes that other cocoons in the same establishment will keep their chrysalides alive through the winter, and that they will be transformed next year at a favourable part of the season for effecting their acclimatization.

XUM

A Sun Fountain.—Prof. Mouchot states that if a thin vessel—silver blackened externally being the best—is filled half with air and half with water, and covered over with two bell-glasses, through which the direct sun-rays penetrate, its contents will grow so hot that, upon turning a stop-cock communicating with the water, a jet will be thrown up thirty feet high. M. Babinet thinks that an apparatus of this sort might be useful in countries like Egypt, in which the solar action is intense and constant.

Kitchen Middens and Deposits in Nova Scotia.—We learn from the *British Colonist*, which is published at Halifax, that the Nova Scotian Institute of Natural Science is prosecuting interesting inquiries into the refuse heaps and deposits on the shores of the inland waters of the province. Some appear comparatively modern; but others apparently go back to times long anterior to the existence of the present races of Indians. The localities that have been examined show the need of further inquiry, and it is expected that a search in the peat-bogs would lead to the discovery of interesting facts.

A Source of Ozone.—*Cosmos* mentions a process of M. Bœlger for obtaining a continuous supply of ozone. He mixes two parts by weight of finely-powdered permanganate of potash with three of sulphuric acid. A mixture of one part of the permanganate with that of the acid, is so powerful an oxydizer as to produce inflammation and explosion if brought into contact with essential oils.

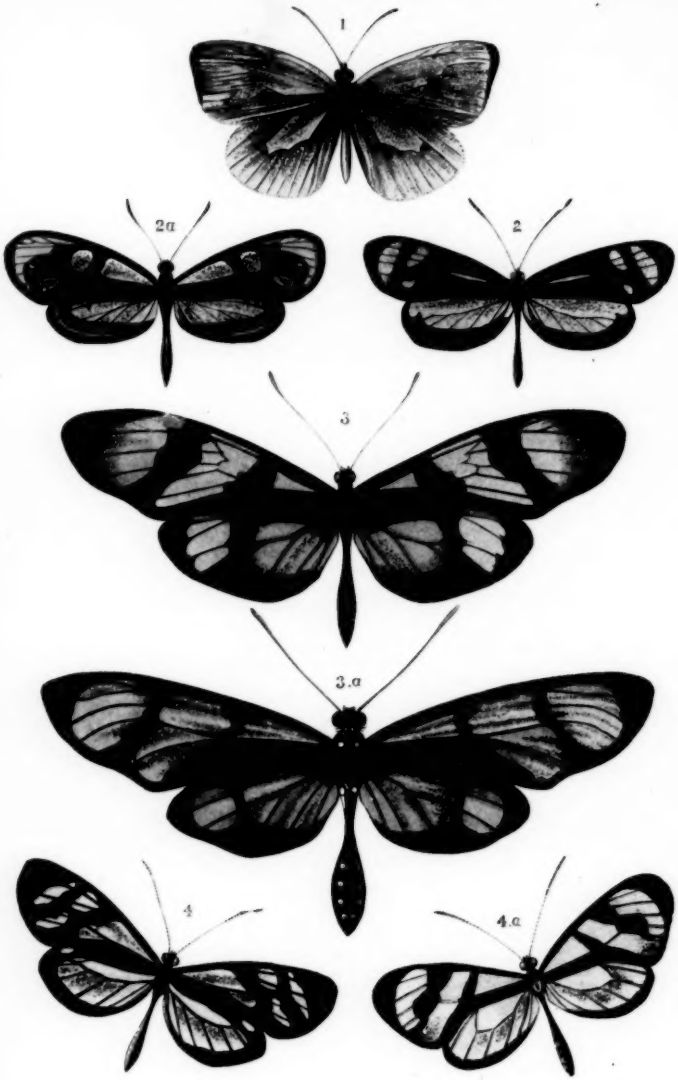
New Variable Star.—Mr. Joseph Baxendell has discovered a new variable star in Delphinus. R.A. 20h. 30m. 51s.9 + 15° 53′.5. He noticed it as of 8·6 mag. on 24th October, 1863, by the end of December it had fallen to 12 mag.; on July 29th this year it was 13·2 mag., on August 21st 9·4 mag., on September 5 8·4 mag.

The Lamprys Italica.—M. Carus states the luminous matter of this insect ceases to shine when dried on a plate of glass; but regains its lustre once or twice if wetted with water.

Fermentation of Wine.—M. Berthelot finds that the skin of grapes bears on its surface not only spores of ferments, but often actual globules, and hence fermentation is easily excited as soon as the grapes are crushed, notwithstanding any precautions to exclude germs floating in the air.

Proposed Solar Eye-Piece.—In a communication published in the *Monthly Notices*, Sir J. Herschel proposes that the sun should be viewed through a fine slit in a disk revolving sufficiently often to give continuous vision, only a small portion of the sun's light and heat would then affect the eye.

XUM



SOUTH AMERICAN BUTTERFLIES.

Illustrating Mimetic Analogy.

1. Leptalis Nehemia.
2. Leptalis Theonoë,
var. Leuconoë.
2a. Ithomia Herdina.
3. Leptalis Orise.
3a. Methona Psidii.
4. Leptalis Theonoë.
4a. Ithomia Flava.

XUM